US Army Corps
of Engineers
St. Paul District

LETTER REPORT

Alternatives Screening Report

Roseau, Minnesota
Flood Control Feasibility Study

April 2005

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See the Feasibility Scoping Meeting Memorandum for information and data regarding the study area inventories, flooding history, the study authority, flood photos, higher authority perspectives, and other related pertinent background.

Scope and Purpose of this Letter Report

A primary purpose of the ongoing Roseau Feasibility Study is to evaluate and document the Federal interest in construction of a flood reduction plan. To identify and coordinate such a plan formulation for the Roseau area, the initial phase of planning focuses on conducting preliminary engineering, economic, and environmental studies to compare possible permanent flood control plans and features. This Letter Report is intended to be an interim informal report and is not a milestone/required report by Corps Higher Authority. It documents the initial and final screening phases of the ongoing Feasibility Study. Accordingly, findings of this letter report will be used to define the selected plan and proceed into more detailed final designs, final cost engineering, and refined benefit calculations. These more upcoming more detailed study efforts will be formalized and documented in a Feasibility Report and Environmental Assessment (EA). This report is also not intended to present a final / recommended design, final cost report, or a definitive budgeting document.

Another primary purpose of this report is to help the planning team and sponsors to identify a selected plan and associated features that should be carried into the optimization design and environmental coordination phases of the Feasibility Study. Information presented in this report will result in further coordination between the non-Federal sponsor and the Government to allow selection of a single flood reduction plan that will be further detailed during the remaining phases of the Feasibility Study. It will also provide information about optional public recreation and ecosystem restoration features that could be integrated into a multi-purpose flood control project.

Findings of this Letter Report will be presented to inter-agency groups, stakeholders/landowners, and the general public in late April 2005. Inputs and concerns from these meetings will be fully evaluated and integrated into the final plans and documented in a draft Feasibility Report and EA. That formal draft Feasibility Report will be distributed for public comment in mid-summer 2005 and public meetings/workshops will again be conducted to obtain additional public and agency comments. Then, comments received will be integrated into the final Feasibility Report and Environmental Assessment. This final report is scheduled to be submitted to Corps of Engineers Headquarters for approval by early August 2005 (Note: The Feasibility Report is a “decision document” that receives interagency comment and will be transmitted by the St. Paul District Commander to the Division Commander and on to the Chief of Engineers in Washington for formal approvals).

If the Feasibility Report shows a favorable/feasible Federal project and the City agrees to cost share implementation of the project and to operate the project, project cost sharing agreements and project authorization would be pursued and final Plans and Specification would be initiated.

Overview of Existing Condition and Problem and Opportunity Identification

Existing Conditions-

The City of Roseau will continue to belong to the National Flood Insurance Program and accordingly will preclude new development in the regulatory floodway, and will require new development outside the floodway but within the 100-year floodplain, be constructed with first floor elevations at or above the median discharge 1% chance flood level. Based on this future development constraining scenario and constraints associated with the Flood Plain Management Executive Order 11988, future flood damages will remain the same as the existing condition -- with no increased development or intensification of use/damageable structures in the study area. According, based on preliminary reconnaissance evaluations, the average flood damages for the Roseau area are estimated to range between $2 million and $3.0 million annually will continue into the future (Note: the annual flood damages expected will be refined in the feasibility study).

The existing temporary/emergency levee system has been evaluated to determine if it is reliable to any level and should be assumed to provide any level of protection. This credit-to-existing levees has determined that the presence of landslides, unwanted large tree growth on levee slopes, encroachments and the lack of information concerning levee materials and construction methods provides significant uncertainty on the future reliability of the existing levees. It is also noteworthy to mention that this levee system recently failed in numerous locations during the 2002 flood. Based on these known deficiencies and uncertainties associated with levee material and construction methods it is assumed that the no-action alternative should not credit the existing levees when computing damages.

The City and the Roseau River Watershed District have a couple of significant internal drainage projects that are currently in the plans and specifications stage of design that are very likely to be completed within the next five years. These projects include:

A west intercept ditch, which will be located on the west side of Roseau and will intercept overland interior stormwater and divert stormwater drainage flows into the Roseau River downstream of Roseau. This will help to solve some of Roseau's interior flood control problems but will not address the flooding risks originating from Roseau River flooding.

Some plans to construct new interior flood control ponds and/or pumping stations are also being prepared by the City and the City is coordinating the design of these IFC features to meet Corps standards. The likelihood of these improvements being funded and constructed is uncertain but appears likely within the next 5 years. Therefore, these IFC features are assumed to be part of the future without project conditions and are being coordinated extensively. It is important to note that these new IFC features will address only interior flood damages associated with non-river flooding. Therefore, the direct river related flood damages will remain the same as the existing condition river induced flooding.

A number of relatively small segments of new emergency levee are being designed now and will be constructed to replace sections of the emergency levee that failed during the 2002 flood – primarily as a

short-term fix of the temporary levee system. These segments are being designed by the City to meet Federal design standards that would allow them to tie into a Federal permanent levee system – if such a permanent levee system should be a reality later. These new local levee segments will provide reliable levees for short reaches and are intended to enhance the local flood fighting capability and were evaluated using geotechnical and other credit-to-levee evaluations to determine their reliability (see the credit-to-levee evaluation details in the Geotechnical Working Papers). However, these new levee segments would still be tying into an unreliable existing temporary levee system and these short reaches of "good levee" will not substantially affect the high risk of failure of the local levee system.

Identified Objectives, Problems, and Opportunities -

The water resource related problems and opportunities associated with the larger context basin-wide and sub-basin area were presented in the August 2003 Section 905(b) Analysis for the Roseau River Subbasin (see that report for detailed basin wide and subbasin perspectives of problems and opportunities). Efforts by the project delivery team were made to collect and generally summarize basin-wide problems and opportunities (i.e., these originated from reconnaissance phase coordination with stakeholder and interagency coordination). In addition, discussions with City officials, State and watershed officials, and county officials have resulted in the identification of specific localized objectives, concerns/problems, and opportunities for incorporation into the Roseau project formulations. These are first identified in the Section 905(b) report and are shown as follows.

PRIMARY PROBLEM – On 9-11 June 2002, intense rain fell over the Roseau River basin, dumping an extraordinary amount of water into the study area (as much as 11 inches of rain fell in some locations). This water quickly collected and drained into the Roseau River, overflowing the City of Roseau's emergency levee system and flooding most of the area. All the structures in town with the exception of the high school and several manufacturing buildings were flooded. The flood damage was enormous, with significant damage to downtown businesses and private residences, and city services were affected significantly for months (an estimated $50 million of damages to city public and hospital buildings, streets, and public utilities occurred to Roseau during this flood. More than 50 homes, many owned by low-income families, were demolished as a result of the flood. The Roseau County Museum, Interpretive Center, City Hall, and Library also needed to be demolished. This major flood lasted for several weeks, with heavy impacts to over 80 percent of the town. Total damages for this single event have been estimated at over $120 million and resulted in major hardships to the entire city. Recovery is still ongoing (see photo below for view of the Roseau 2002 flood).

OBJECTIVE – The primary objective of this study is to define an implementable permanent flood protection project that will significantly reduce the long-term risk of catastrophic flood damages to Roseau, Minnesota. This project needs to be technically feasible from an engineering and economic perspective.

OBJECTIVE – Another important objective is that a project not cause induced damages to areas upstream or downstream of the study area and that the "opposite side of the river" from any proposed project features is minimized. In response to this objective, hydraulic project design criteria will be established to avoid flood reduction actions that would cause induced stage impacts upstream or downstream.

Photograph - The June 2002 Roseau River flood caused devastation to Roseau

CONCERN – After the temporary levee systems at Roseau were overtopped during the 2002 flood, there was growing local concern about reliance upon levee systems for permanent protection. There was also strong local support for alternative solutions that would minimize further social impacts (e.g., locals fear that setback permanent levees would significantly impact the community and would also make the existing housing shortage more acute). As a result of these concerns, the Corps will be analyzing several possible diversion plans that would reduce or eliminate levees in town.

CONCERN – During the 2002 flood, there was considerable stage increase associated with the existing in-town railroad bridge. As a result, there is local desire to remove or enlarge the embankment opening at that bridge to help reduce flood stages in town. An evaluation of this problem will be done as part of the feasibility study.

CONCERN – Citizens and city officials are concerned about the probable negative spiral effect that another major flood or floods would have on the community. Specifically, if a major flood breached the existing temporary levee system, many structures would be damaged to the point where they would need to be condemned and removed. Another traumatic flood event with damages at Roseau would be difficult to overcome. From social and economic perspectives, the concern is that these flood-induced actions would significantly decrease available housing, decrease community and neighborhood cohesion, adversely affect local property value and the tax base, and likely result in a decline in the community population. It could also have adverse affects upon regionally significant business – especially the Polaris plant located within Roseau.

CONCERN – From an engineering perspective, the major geotechnical constraint is the potential for poor riverbank and levee foundation stability. The instability is caused by a combination of the geologic and geomorphologic conditions in the area. A typical location where stability is of greatest concern is on the

outside of a meander in the river, where erosional forces are highest. The erosional nature of the river, combined with the weak lacustrine soils deposited in the geologic past, contributes to the riverbank and levee foundation stability problems throughout the study area. Levees located near or on the outside of meanders will most likely need to be set back several hundred feet from the riverbank, resulting in removal of houses and other related structures. Floodwalls and mechanically stabilized earthen wall designs have already been used in numerous locations along the project alignments presented in this report in the ongoing efforts to avoid impacts to structures and critical infrastructure such as roads and utilities. Additional potential techniques to move the levees/floodwalls riverward to protect additional existing structures are being analyzed but are not available for this report. When those detailed evaluations are complete, they will be used to refine the project alignments where possible -- from economic, engineering, and environmental perspectives. These detailed evaluations will require additional field data collection and analysis that is now under way

CONCERN – An environmental issue that could affect project design is the potential presence of hazardous, toxic, or radioactive waste (HTRW) materials. To assess the study area for potential HTRW materials, and for other contaminated materials that may not meet the strict definition of HTRW materials (as defined in ER 1165-2-132), an Environmental Site History will be completed and Phase I Environmental Site Assessments (ESAs) and Phase I field investigations will be completed for the study area.

OPPORTUNITY – The City has recently conducted public and design team workshops to look at future community recreation and environmental quality measures. As a result of these discussions, the city has now asked that recreation, ecosystem restoration, and aesthetic features be evaluated and integrated into the feasibility flood reduction plan formulations. Such opportunities will be identified and integrated where possible.

CONCERN – Construction of a flood control project could affect historically/culturally significant structures located on the current project alignment. The extent of the impacts is not yet fully defined; the planning and design phases will evaluate such effects and seek to avoid or minimize any damages to such structures.

CONCERN – Three Federally designated threatened species are listed for Roseau County. These species and their critical habitat needs will have to be carefully considered in the alternative selection and design phases in order to avoid and/or minimize impacts to these species.

CONCERN - There has been considerable effort by USFWS, the MDNR, the Corps of Engineers, and other managing agencies to restore or maintain fish passage on the Red River and its tributaries. Care to prevent blocking fish passage on the Roseau River is a formulation constraint.

OPPORTUNITY – Water resource studies conducted by Federal, watershed, State, and local levels of government have identified flooding of Roseau as a critical problem in the Red River basin. Accordingly, Minnesota has taken steps to assist floodprone cities, including Roseau, in funding Federal flood control studies and in preparing detailed design reports and plans and specifications. The State has also indicated a willingness to assist in the construction of project features to substantially reduce the cities' financial costs. The combined financial resources of identified non-Federal and Federal sponsors make a significant permanent flood reduction project possible. As a result, the City of Roseau has signed the FCSA and expressed a willingness and capability to serve as the non-Federal sponsor.

OPPORTUNITY – Substantial areas in Roseau area were severely affected by the flood of 2002. Much of this area has already been purchased from the landowners. This is clearly a traumatic experience for the people directly affected by the flood and buyouts. These buyouts, however, provided public open space

near the river that offers new opportunities for setback levees, greenway development, and reclaimed environmental habitat.

OPPORTUNITY – Historically/culturally significant structures could be protected from high risk of flooding as a result of implementing a major permanent project. This would provide an opportunity to protect those structures from future floods.

OPPORTUNITY – The portion of the Roseau River between the town of Roseau and the Canadian border has been significantly degraded. Where possible, natural design principles should be used to restore more natural, pre-development conditions. Other high quality reaches of the river need to be maintained or possibly enhanced with ecosystem features.

OPPORTUNITY – Loss of base flow in the river has been one of the significant factors in the degrading of the river. Activities such as restoring upstream wetlands and development of off channel water storage areas to attenuate peak flows and stabilize hydraulic conditions as well as protecting existing areas that accomplish these goals should be pursued.

OPPORTUNITY – Establish or improve the riparian corridors along waterways (including ditches); encourage the use of native vegetation.

OPPORTUNITY – Where the river channel has been substantially enlarged for flood control purposes, a more natural stream channel configuration for low and average flow conditions should be established.

Overview of Screening Process

The general formulation strategy and sequence of the plan formulation used for this study follows:

- Define array of possible primary and secondary features
- Analyze a range of capacities/sizes for each of the identified features as a standalone feature (from a cost and benefits perspective and a engineering effectiveness perspective)
- Determine the most cost effective size for each feature - via comparing net benefits associated with each feature (Note: this is to be used to establish project feature sequencing with the feature having the highest B/C being the first in place feature).
- Determine the extent that this cost effective sized feature could meet the overall project design objectives. Those features that are primary feature that will significantly solve the problem are defined and those secondary/lesser features are defined as ways to tweak the formulation…
- Identify combination plans of primary features and rank features to be integrated using relative B/C as method to sequence first and last in place…
- Analyze the combined plans so as to optimize the primary features
- Analyze the secondary features as add-on tweak features to see if when added each is justified – as last in place features thereby optimizing the formulation as the NED plan.

- Determine the overall level of Flood Protection that the NED plan would provide and compare that to the desired project design objectives.

- Coordinate with Sponsors and stakeholders to determine if optional recreation and environmental restoration features are to be integrated into multi-purpose project.

- Define the recommended plan by making, as needed, adjustments to the NED plan via betterments or via NED exceptions to define a Locally Preferred Plan. And, integrate fully coordinated multi-purpose features, as desired by Sponsors.

- Document the NED and Recommended Plans, if different.

The St. Paul District, Corps of Engineers completed a Section 905(b) Analysis for the Roseau River Subbasin in August 2003. That approved report identified a number of possible flood reduction plans and features that showed a strong potential to become a Federal project. Based on recommendations contained in the reconnaissance level study, the City of Roseau and the Federal Government entered into a Feasibility Cost Sharing Agreement, and feasibility studies were initiated in September 2003 (Note: the non-Federal and Federal Government each pay 50% of the cost of the Feasibility Study). Since that time, considerable data has been collected and analyzed and a preliminary evaluation of possible alternative plans for flood reduction at Roseau and the surrounding study area has been completed and is documented in this letter report.

The initial and final screening of alternatives documented in this report was done consistently to allow consideration and comparison of a variety of possible alternatives; It is important to note that environmental coordination associated with the various alternatives is still ongoing and the cost engineering and environmental assessments generated as a result of these preliminary evaluations are now at a relatively rough level of detail. The economic analysis has been done at a greater level of detail, but these inventories and evaluations are not finalized and could be supplemented prior to completion of the Feasibility Study. Yet, at this point in the study process, the costs and benefits generated and presented by this letter report are considered accurate enough to fairly compare the plans against each other and determine the likely feasibility of each plan.

Plan Descriptions, Initial Comparisons, and Findings

The results of past flood reduction studies conducted on the Red River and more specifically in the Roseau River watershed were researched for possible application, and many possible flood reduction strategies were considered for implementation at Roseau. Alternative flood reduction plans and features that were identified during the Reconnaissance phase/Section 905(b) Analysis study have also been reviewed, refined, and further evaluated.

Scoping meetings were held with the public and agency representatives as part of this feasibility study to help identify existing and future without project conditions, to identify water resources problems and opportunities, and to identify possible alternative flood control solutions. This has lead to identification of additional flood reduction features that have been added the array of alternatives evaluated and screened.

A graphic (exhibit 1) showing the various plans being considered in this feasibility study screening.

It is important to note that the flood reduction alternative measures considered would provide enough flood damage reduction so as to be primary features and other measures evaluated could only be viewed as secondary features that might be used in combination with primary measures (e. g., modification of the railroad bridge could only reduce flood stages by .2 to .3 feet for a small downstream reach, could not physically meet the flood reduction objectives as a primary feature because it would not be a solution as a standalone plan).

When screening alternatives, the flood reduction outputs of each feature were compared against other flood reduction measures/plans with similar outputs. In this way the screening could eliminate plans that realized the same flood reduction output at greater expense. The screening of alternatives was done using comparisons of net benefits; the alternative with the greater net benefits for a similar flood reduction outputs was carried further in the formulation and those with comparatively less net benefits were dropped from more detailed study. Using this approach the following plans were pitted against each other during the screening process:

Large Diversion Plan and a Large In-Town Levee System – Two major diversion plans/alignments and a large permanent Levee System were compared against each other; An east aligned diversion and a west aligned diversion and a citywide levee system could provide a high level of flood reduction to all the study area.

Smaller Diversion and Cutoff Channels – Smaller North Diversion, Northeast Diversion plans and two high-flow cutoff channels were compared against each other. These features provided the opportunity for limited flood reduction to only smaller portions of the study area.

In-Town Channel and Bridge Modifications – There are a number of very localized measures that could provide limited stage reduction to small river reaches in the study area. These secondary features were evaluated in terms of how they could be used in combination with other primary features to mitigate impacts or optimize flood reduction.

See table 1 for a summary descriptions of these alternatives and the findings associated with the analysis and screening of alternatives. Note that an “existing without project condition” is presented in the comparative analysis to provide a baseline context to compare against the features considered.

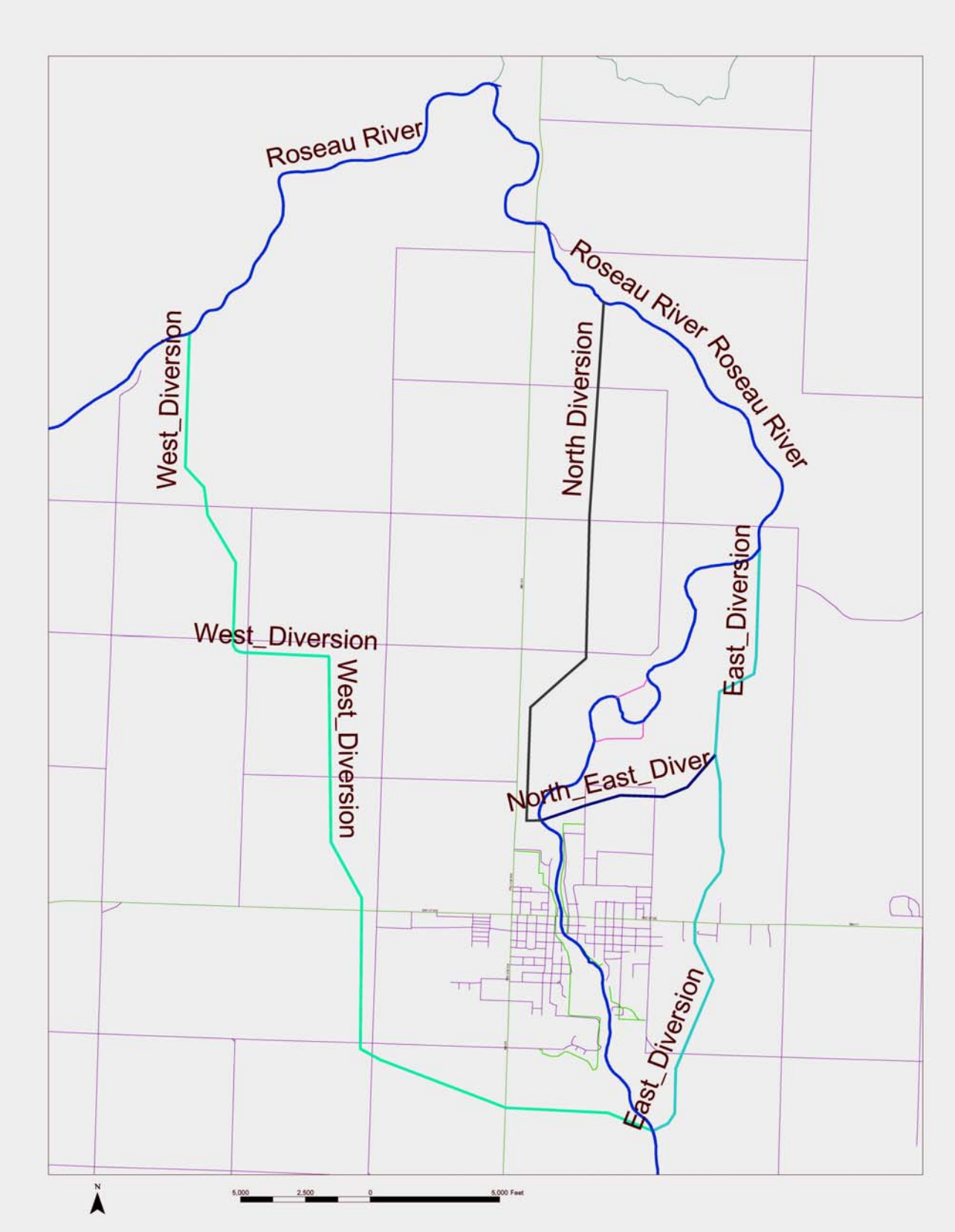

Exhibit 1 - Alternatives Considered

Table 1 - Comparison Of the Array of Alternatives

Alternative Features	*Design Summary Description*	*Range /Approx. Cost*	*Net Damage*	*Social, Political, Environmental, and Engineering Implications*
Existing Condition "No Action" Plan (including future without project conditions)	The city will continue to rely on a local emergency levees system and heroic flood fighting for flood protection. Some multipurpose upstream reservoir/storage projects may be constructed but would only reduce major flood stage by less than a foot, which leave Roseau highly susceptible to future founding.	This is a no action alternative Therefore, costs are put in the form of likely flood damages that would occur over time for the City. It is estimated that the **average annual flood damages that would continue to occur without a project would be about $3,000,000 annually.** (See Hydrology & Hydraulic, Economic, and Environmental working papers for additional details).	This is a **no action plan;** therefore there would be continued and unaccept-able risk of major flood damages.	A new regulatory floodplain will need to be established by FEMA if a Federal flood reduction plan is not implemented for Roseau. It is likely that the hydrology to establish the Roseau area Flood Insurance Maps will be updated to account for recent large flood events. This would result in a large portion of the city being located in the regulatory floodplain and subject to National Flood Insurance requirements. Reliance on flood insurance to reduce damages is not a socially acceptable alternative. If this without project condition continues, the economic health of the community is likely to decline in a spiral effect. This is because future flood damages would occur and would erode citizen confidence, perpetuate flood related citizen fears, reduce population, impact adversely housing and business valuations, and reduce tax base. Risk of future catastrophic flood losses and possible loss of life remains high. The City and the Roseau River Watershed District have a couple of significant internal drainage projects that are currently in the plans and specifications stage of design that are very likely to be completed within the next five years. These projects include: A west intercept ditch, which will be located on the west side of Roseau and will intercept overland interior stormwater and divert stormwater drainage flows into the Roseau River downstream of Roseau. This will help to solve some of Roseau's interior flood control problems but will not address the flooding risks originating from Roseau River flooding. **Based upon recent catastrophic flood events and the socio-economic impacts of this flood, continuation of this existing without project condition is not deem to be a prudent option.**

Alternative Features	*Design Summary Description*	*Range /Approx. Cost*	*Net Benefits*	*Social, Political, Environmental, and Engineering Implications*
Upstream Flood Water Storage	The Roseau Watershed District and the MDNR are currently coordinating a number of potential multi-purpose impoundments upstream of Roseau would provide some flood storage that could reduce the 100-year flood stage at Roseau. However, the affect of such reservoirs is expected to have less than a 1-foot stage reduction affect at Roseau during large floods. Therefore, this alternative is not a standalone flood control solution for the Roseau area.	**With Federal construction the approximate costs are assumed to be in the range of $15 to $60 million** (Depending on the size of the storage capacity of these structures)	**Not known** The multi-use of these reservoirs may make them feasible. However, flood reduction benefits are likely only a small portion of the total benefits.	Additional upstream storage would need to be implemented at additional cost (beyond the $15-50 million shown) to allow this strategy to be effective as a primary flood reduction plan for Roseau. Public lands and/or farmland would need to be acquired to implement such upland storage project and environmental impacts to existing habitat would occur. However, mitigation requirements associated with implementation of upstream storage projects would most likely not be significant (i.e., the footprint of the reservoir would not impact important habitat but would likely require some wetland mitigation). The regional scale and nature of benefits associated with this alternative and the magnitude of stage reduction make this an important longer range secondary flood reduction feature/project. These long range regional storage projects should be pursued as a future means of providing an additional level of flood protection and safety --- but not relied upon as the primary means of local flood protection at Roseau. Based on these evaluations, **this plan was dropped from detailed evaluation** as part of this Feasibility Study**. However, other ongoing study efforts to pursue such flood reduction upstream features do have merit and should continue via separate studies.**
Alternative	*Design Summary*	*Range /Approx.*	*Net*	*Social, Political, Environmental,*

Features	***Description***	***Cost***	***Benefits***	***and Engineering Implications***
Large Diversion Plans **++ West Aligned Diversion Channel**	The West Diversion channel would be constructed west of the Roseau River and would split flood water flows between the river channel and a excavated diversion channel. This channel would not begin to carry flows until a 2-year or larger flood event. It would involve channel excavation of a 300-foot bottom width, construction of a number of bridges, tieback levees, a channel restriction structure, and an inlet control structure.	The prel. cost for for this plan were calculated to be **$43.7 million**. Preliminary quantities were determined for a 300-foot West Diversion Plan and were compared to a similar capacity East Diversion Plan in the initial screening. The results showed that much more excavation, more bridges, more and more expensive real estate would be needed to implement the West Diversion. Based on these comparisons this alternative was dropped from detail evaluations.	Initial screening showed that this plan would have at **least $1 million <u>less</u> net benefits than the East Diversion Plan.**	This feature/alternative could serve as a primary flood reduction plan or as a feature to be combined with other flood reducing features. It would reduce flood stages and remove large portions of the study area from the regulatory floodplain. **This diversion plan was not as cost effective and had appreciably greater social and environmental impacts and less net benefits than East Diversion plans. Based on these comparisons this alternative was dropped from detail evaluations as a result of the initial screening.** .
Alternative	***Design Summary***	***Range /Approx.***	***Net***	***Social, Political, Environmental,***

Features	*Description*	*Cost*	*Benefits*	*and Engineering Implications*
Large Diversion Plans **++ East Aligned Diversion Channel**	This diversion channel that would be built east of the Roseau River and would split flood water flows between the river channel and a excavated diversion channel. A BW of 50 feet , BW of 150 feet, and a BW of 350 feet were evaluated. All the plans would begin to carry flows after a 2-year or larger flood event. It would involve channel excavation, and construction of tie back levees, 2 bridges, a main channel restriction structure, and an inlet control structure.	Three sizes of this alternative were analyzed because this plan made it to the final screening. **$13.8 million** for 50-foot bottom width design **$22 million** for 150-foot bottom width design **$31.3 million** for 350-foot bottom width design. **See the Cost Engineering and General Design working papers for more details.**	**1,103,000** average annual net benefits **1,210,000** average annual net benefits **924,000** average annual net benefits	This feature/alternative could serve as a primary flood reduction plan or as a feature to be combined with other flood reducing features. It would reduce flood stages and remove large portions of the study area from the regulatory floodplain. Implementation of this alternative would require acquisition of lands from a few farms and/or commercial lands. This diversion plan was more cost effective and has greater net benefits than the other diversion plans and the intown levee plans. The 50-foot bottom width design has been shown to be the most optimal in the preliminary optimizations. This plan when combined with increments of low intown levees may have the greatest net benefits and needs to be further evaluated. Mitigation requirements have not yet been fully coordinated for this feature and final tweaking of the design will be needed to avoid mitigation - to the extent possible (e.g., the river restriction structure proposed in the preliminary plans may be changed or eliminated in the final plans after further coordination with natural resource officials). Ecosystem and recreation features may also be added as optional features to this plan and such features have the potential of enhancing the overall net benefits possible. **The detailed screening evaluations done during this Feasibility Study identify that the 150-foot bottom width design of this plan has the greatest net benefits as compared to all other plans. Therefore, this plan has been identified as the "selected plan". However, this plan, in combination with intown levee tweaks, has the potential to meet planning objectives and of having higher net benefits than the stand alone 150-foot East Diversion Plan. Plus, the integration of recreation and environmental features could further improve the net benefits associated with a recommended plan.**
Alternative Features	***Design Summary Description***	***Range/Approx. Cost***	***Net Benefits***	***Social, Political, Environmental, and Engineering Implications***

Permanent Levee/ Floodwall System Levee plans are being looked at as a single increment due to the natures of levees to induce stage if they are implemented only on one side of the river.	Certifiable permanent flood levees and floodwalls would be constructed on both the West and East sides/increments to provide approximately 25-, 100-, and 500-year level of protection. In order to minimize upstream impacts, modification of the Railroad bridge is necessary as a secondary and mitigating feature to be combined with the levee plans.	Three sizes of this alternative were analyzed because this plan made it to the final screening. **$24.2 million** for 25-year barrier **$28.4 million** for 100-year barrier **$31.7 million** for 500-year barrier **See the Cost Engineering and General Design working papers for more details.**	**188,000** average annual net benefits **1,189,000** average annual net benefits **1,074,000** average annual net benefits	An integrated permanent citywide levee feature would significantly upgrade and extend the City's existing temporary levee system – but as standalone feature, large levees would have adverse short-term social impacts due to affects to existing structures. This feature could serve as a primary flood reduction feature (other secondary features might be added to it in the detailed optimization and design phases to help reduce the levee heights and associated social impacts). All the designs developed show a likely induced stage to areas upstream of the City. Implementation of the 100-year and 500-year permanent levee system would remove the city from the defined regulatory floodplain. Implementation of this feature would require acquisition, removal, or relocation of many intown structures to make room for a large levee system. In fact, if this alternative were to be further pursued there would be a need to setback the levees and open up the river channel more to eliminate induced affects upstream. Historic or cultural mitigation may be required in order to implement all reaches of this feature (this potential will be further evaluated during plans and spec). No natural resources based mitigation is assumed to be needed (Note: additional studies are planned to refine and fully coordinate these mitigation assumptions and the taking actual structures taking requirements). Integration of recreation and aesthetic features into greenway and trail ways is an opportunity that will be evaluated for the permanent levee system. Although the 100-year levee system was the most optimal size and it is economically feasible, it does not have as many net benefits as the 150' East Diversion Plan. And, it is important to note that these levee plans, as designed, have induced upstream impacts that would require major increases in setbacks and costs to implement. So, the net benefits for the levee plans would erode with more detailed design and cost engineering. Therefore, **this alternative was dropped as a standalone plan as the result of the final screening. However, it is possible that small reaches of low levees may still be used to enhance and further optimize the East Division Plan. This will be further evaluated in the final optimization.**
Alternative Features	***DesignSummary Description***	***Range /Approx. Cost***	***Net Benefits***	***Social, Political, Environmental, and Engineering Implications***

Smaller Diversions **++North Aligned Diversion Channel**	This diversion channel that would be built North and west of the Roseau River and would split flood water flows between the river channel and a diversion channel. A BW of 50 feet , BW of 200 feet, and a BW of 400 feet were evaluated. All the plans would begin to carry flows after a 2-year or larger flood event. It would involve channel excavation, and construction of tie back levees, 2 bridges, a main channel restriction structure, and an inlet control structure	Based on preliminary costs engineering for this plan, costs were calculated to range from about **$6 to 17 million** .	Initial screening showed that this plan would have at **least $0.5 million <u>less</u> net benefits than the East Diversion Plan**	This feature/alternative would serve to reduce stages upstream in town but would have progressively less stage reduction affects as you go upstream of the inlet channel opening (with stage reducing affects being lost at the railroad bridge). As a result of the limited area of stage reduction that is possible with these plans, they are not primary flood reduction plans as standalone projects but could provide localized stage reduction when combined with other features. Implementation of these features would require acquisition of lands from a few farms and/or commercial lands but social impacts would be relatively small compared to other diversions. Mitigation requirements have not yet been coordinated for this feature. **This diversion plan was not as cost effective and has net benefits than the larger East Diversion plans. Based on these comparisons this alternative was dropped from detail evaluations**
Alternative Features	***DesignSummary Description***	***Range /Approx. Cost***	***Net Benefits***	***Social, Political, Environmental, and Engineering Implications***

Smaller Diversions **++Northeast Aligned Diversion Channel**	This diversion channel that would be built North and east of the Roseau River and would split flood water flows between the river channel and a diversion channel. This channel would be approximately 4 miles long. It would not begin to carry flows until a 2-year or larger flood event. It would involve a 50-foot bottom width , 200-foot bottom width, or a 400-foot bottom width channel excavation, and an upstream control structure.	**Prel. Costs ranged from about $5 million to about $15 million**	The 400-foot bottom width Northeast diversion channel plan was the most efficient of the 3 evaluated However, that plan still had about **$400,000 <u>less</u> net benefits when compared to the East Diversion Plan.**	This feature/alternative would serve to reduce stages upstream in town but would have progressively less stage reduction affects as you go upstream of the inlet channel opening (with stage reducing affects being lost at the railroad bridge). As a result of the limited area of stage reduction that is possible with these plans, they are not primary flood reduction plans as standalone projects but could provide localized stage reduction when combined with other features. Implementation of these features would require acquisition of lands from a few farms and/or commercial lands but social impacts would be relatively small compared to other diversions. Mitigation requirements have not yet been coordinated for this feature **This diversion plan was not as cost effective and had less net benefits than the East Diversion plans. Based on these comparisons, this alternative was dropped from detail evaluations**
Alternative Features	***DesignSummary Description***	***Range /Approx. Cost***	***Net Benefits***	***Social, Political, Environmental, and Engineering Implications***

Modify Channel / River Bank Unloading Modifications	A variety of in-town channel modifications were considered. These were largely integrated with permanent levee plans.	These costs were integrated into the levee design alternatives (the river side slope were cutback to accommodate setback levees for the levee plans evaluated).	**NA**	The stage reduction possible from these channel mod features is limited and would result in considerable social and environmental impacts (riparian vegetation impacts and a need to buyout numerous structures along the riverbanks. Also, because this feature has very limited stage reducing capability and the affect it would have are limited to only portions of the study area it is not considered a viable stand alone feature. **To avoid unnecessary social and environmental impacts, this alternative was dropped from further consideration after the initial screening.**
High-flow Channel Cutoffs	Two downstream channel cutoffs were evaluated. These are located on the downstream end of the study area.	This alternative was costed out at **approx. $4.2 million** during the initial screening.	This plan still had about **$120,000 less net benefits when compared to the East Diversion Plan**	Each of these will be designed so that the bypass does not begin to function until a 3-5 year flood stage is realized... **Because this feature has very limited stage reducing capability and the affect it would have are limited to only portions of the study area it is not considered a viable stand alone feature and it was dropped from further consideration after the initial screening.**
Alternative Features	***Design Summary Description***	***Range/Approx. Cost***	***Net Benefits***	***Social, Political, Environmental, and Engineering Implications***

Railroad Bridge Modifications	In-town channel modifications at the existing railroad bridge was evaluated from a hydraulic perspective and it could reduce upstream stages by .2 to .3 feet. It was assumed that the railroad bridge embankment was excavated and a bridge span added to increase the flow capacity through the bridge.	**Approx. $2 million** for embankment modifications	This plan still had about **$20,000 <u>less</u> net benefits when compared to the East Diversion Plan.**	The relatively small stage reductions realized by implementing this feature would make this feature a secondary flood reduction feature that might be combined with other features. This could be particularly important if mitigation of upstream stage reduction is needed to offset induced affects of other larger flood control measures. **Because this feature has very limited stage reducing capability and the affect it would have are limited to only portions of the study area it is not considered a viable stand alone feature and it was dropped from further consideration after the initial screening.**
Alternative Features	***Design Summary Description***	***Range/Approx. Cost***	***Net Benefits***	***Social, Political, Environmental, and Engineering Implications***

Non-Structural Measures NOTE: Recreation and Ecosystem features and associated benefits can be incorporated into a multi-featured multi-purpose flood reduction project formulations when relocations are utilized.	Includes floodproofing, elevating, and relocating structures measures. These flood damage reduction measures can be looked as standalone features or in combination with structural flood control features.	**Floodproofing:** (Typical cost per residential structure for floodproofing is $15,000 to $35,000) **Elevating:** (Typical cost per residential structure for elevating is $20,000 to $40,000) **Relocations:** (Typical cost per residential structure for relocating is $35,000 to $60,000)	Reach by reach evaluation would be needed…	Floodproofing measures can be taken that protect basements and move damageable utilities to the first floor to minimize flood damages. Etc... Generally, such measures can be effective for isolated and/or clusters of structures located near the river that have an infrequently flooding risk and/or for structures that are difficult to protect with more traditional structural measures. However, floodproofing is does not provide effective protection against larger floods and is not cost effective for entire communities. Elevating is effective for isolated or clusters of structures located near the river that have an infrequently flooding risk and/or for structures that are difficult to protect with more traditional structural measures. It also would be and effective strategy for new development that is to occur in the floodplain. However, elevating structure has limitation in that it does not provide effective protection against larger floods, generally is not cost effective for entire communities, and does not provide a basis for flood fighting for large events... Relocations could be effective for isolated or clusters of structures located near the river that have an infrequently flooding risk and/or for structures that are difficult to protect with more traditional structural measures. It is generally not an effective strategy for protecting existing communities. A combination of floodproofing, elevating, and relocations can be combined with structural measures effectively on a reach-by- reach basis to optimize other standalone features. **Based on the very flat topography in the study area and the high number of structures that would need to be transformed or removed using non-structural means, this alternative was dropped from further consideration during the initial screening. However, it is possible that non-structural measures will be a valuable tool in combination with other primary plans that are feasible.**
Alternative Features	***Design Summary Description***	***Range/Approx. Cost***	***Net Benefits***	***Social, Political, Environmental, and Engineering Implications***
				The inclusions of ecosystem and recreation features are optional features to the

Ecosystem Restoration and / or Recreation /Greenway Features	Habitat restoration or creation and other forms of national ecosystem restoration will be evaluated to see if such features can be integrated into the overall plan formulation. Recreation and related greenway features will also be evaluated and integrated into multiple-purpose formulations. This could take the form of trails, overlooks/ interpretive, and other day use facilities.	These types of features are evaluated on the basis is cost per habitat unit and features are looked at on a case-by-case evaluation for feasibility. Generally, public recreation features can be tailored to be very cost effective and offer an opportunity to enhance the overall net benefits of a favorable flood reduction project.	Habitat benefits and costs are evaluated as a separate purpose and increment It is expected that such features will be very feasible and would tend to increase the overall net benefits of a project – if integrated.	formulation but could greatly enhance the overall affects of the Federal project. The City has indicated a willingness to consider such options. Also, integration of recreation and ecosystem features would also have the affect of increasing the overall project Benefits to Costs ratio and that would enhance the projects' feasibility and activeness when it is being evaluated for funding in Washington. A conceptual proposal for integrating of optional multi-purpose features includes: – A multipurpose walking/biking trail – A motorized trail utilizing the flood reduction features— – A parking area at the junction of the project and Highway 11 would provide additional functionality to the proposed recreation features. – Sanitary facilities at the parking area – A sledding hill, constructed with spoil from the channel excavation. . – The possibility of a canoe trail on the Roseau River, extending from the upstream diversion structure through the city to the downstream channel outlet. A short portage at the dam would be required, which could also function as a midway takeout/put-in point on the trail and an access to the dam area for area fishers. This feature would require three small gravel-parking areas. – A nature trail loop could extend from the walking trail into the habitat restoration areas, it could include interpretive signage and an overlook/rest area. – A small picnic area with tables and grills, location to be decided after further analysis. (See conceptual plan in Recreation working papers) **Ecosystem and recreation features are optional features that will be further evaluated in the final optimization of the selected plan.**

Preliminary Optimization, Findings, and Selected Plan

Identification of the Selected Plan:

Based upon these screening evaluations, it is clear that of the primary features evaluated, the Upstream Storage, West Diversion Plan, North Diversion Plan, Northeast Diversion Plan, and Downstream High-flow Channel Cutoffs, and In-Town Levee System Plans are not feasible or are not as feasible as the East Diversion Plan (i.e., the East Diversion has greatest net benefits). Modifications to enlarge the existing river channel and modifications of the railroad bridge would not be feasible as standalone features. Accordingly, those screened out features do not warrant further evaluations or design as primary solutions. The primary flood control plan warranting further detailed evaluation and optimization as part of this ongoing feasibility study is the East Diversion Plan (This is the "selected plan" and is the focus of more refined designs to be pursued during the remainder of this Feasibility Study). However, it is noteworthy that the In-Town Levee System 100-year Plan is economically feasible and could still become the selected plan if unanticipated added costs for the East Diversion Plan are identified during final plan optimization and cost engineering (i.e., the 100-year levee plan is a fallback plan that has been determined to be feasible from a national perspective – But, it is not as feasible as the 150 foot Diversion Plan).

Optimization:

Based upon analysis and findings of the preliminary optimization done for the East Diversion, it appears that a 150-ft bottom width East diversion plan is close to the optimized size for that feature. However, in upcoming more detailed optimization evaluations, the 150-foot bottom width East Diversion channel plan may need to be slightly increased in size or combined and tweaked with a low permanent Federal levee on the west side of the River from the Railroad bridge northward through the City and possibly with non-structural features. The intown tweaks would involve evaluation of small reaches of permanent levees in town and non-structural reached to minimize the size and cost of the East diversion channel. Such a tweaked multi-featured diversion plan is likely to optimize the flood reduction net benefits and could also realize the flood reduction objective of getting the City of Roseau out of the 100-year regulatory floodplain.

It is also recognized that a there is an opportunity to tweak and refine the preliminary optimization done as part of this screening report through integration of recreation and/or ecosystem features. The addition of these features could significantly improve the net benefits and Benefits to Costs ratio for a recommended multi-purpose project.

The findings of this letter report will provide a basis for ongoing coordination among local, State, and Federal Governments and will be incorporated into a Feasibility Study and Environmental Assessment (EA). The upcoming study efforts needed to complete the Feasibility Study and EA include:

Final optimization of the selected plan/features to define the National Economic Development

(NED) plan (or obtain deviations or exceptions, as needed). This also will involve preparation of a more detailed baseline cost estimate for the recommended plan.

It is also possible that a locally preferred plan will need to be prepared in order to meet the local flood reduction objectives. This locally preferred plan could take the form of intown levee system or a larger than the NED plan East Diversion Plan. If such a plan is deemed by the sponsor to be needed, such a plan could become the recommended plan.

Design refinements will be made in the upcoming months to finalize alignments and designs to avoid social and environmental impacts and integrate multiple purposes, as desires of the sponsor and stakeholders become known. Integration of recreation/aesthetic and environmental restoration features into the flood control design are also optional features that may become project features of the recommended plan. To accomplish this upcoming work the following will be needed:

- Additional analysis and formal coordination to fully disclose effects of the proposed plan and definition of any mitigation requirements associated with implementing the proposed project (i.e., this will be accomplished in an EA).

- Additional analysis and refinements on proposed project right-of-way requirements (this will be documented in a gross appraisal and real estate supplement), design quantities, and cost estimates to prepare a Micro-computer Aided Cost Engineering System (MCACES) baseline cost estimate.

- Additional policy and implementation coordination with Local Sponsors and stakeholders, a variety of Governmental offices, and Corps Division and Headquarters offices (e.g., determination of the Federal interest in implementation of any Locally Preferred Plan will need to be intensively coordinated, if applicable).

- Preparation of a draft Project Management Plan and Project Cooperation Agreement. Drafting of a Division Engineer's Notice to transmit this decision document to Headquarters for appropriations.

The non-Federal Sponsor for this project would be the City of Roseau, with financial assistance from the State of Minnesota. Costs for constructing a permanent flood reduction project at Roseau would be cost-shared, with the non-Federal share being not less than 35% and not more than 50%. The actual allocation is dependent on the cost of lands, easements, and rights-of-way needed to implement construction of the project -- consistent with cost-sharing requirements established in the Water Resources Development Act of 1986 (PL 99-662).

Plates and Content of Working Papers

The plates associated with the final screening of alternatives are presented in this Letter Report. They include the following plans:

1. 50-Foot Bottom Width East Diversion Plan
2. 150-Foot Bottom Width East Diversion Plan
3. 350-Foot Bottom Width East Diversion Plan
4. 25-year Permanent Levee System Plan
5. 100-year Permanent Levee System Plan
6. 500-year Permanent Levee System Plan

A summary of the key technical procedures and study team considerations associated with plan formulation up to this point in the study process are presented by functional discipline in the attached "working papers" section. This information is divided into functional areas of work associated with this Feasibility Study.

PLAN PLATES

DRAWING NUMBER: BASIN-T-CC/FNO.01
SHT 999 OF 999

ROSEAU FEASIBILITY STUDY
FLOOD CONTROL
25 YEAR LEVEES

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

ED-D	DESIGNED: JGS/GCW	SCALE: AS SHOWN	DATE: MAR 05
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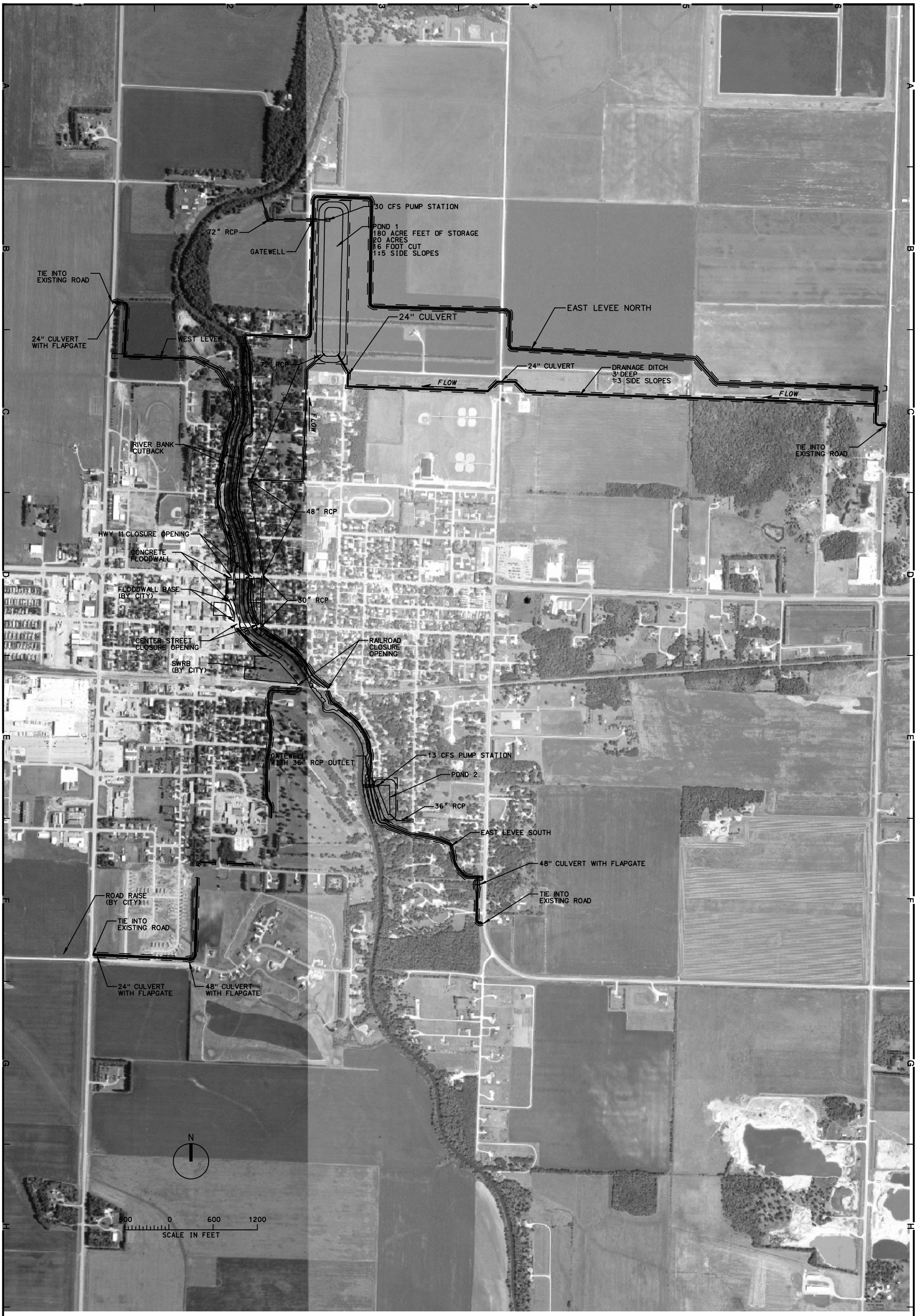
	DRAWN: GCW	SOL. NO: DACW37-01-B-0000	
ED-H	DESIGNED: SMG	AE APPROVING OFFICIAL:	
	CHECKED: XXX/XXX		

Symbol	Description	Date	Appr.

US Army Corps of Engineers
St. Paul District



DRAWING NUMBER: BASIN-T-CC/FNO.01
SHT 999 OF 999

ROSEAU FEASIBILITY STUDY
FLOOD CONTROL
100 YEAR LEVEES

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

ED-D	DESIGNED: JGS/GCW	SCALE: AS SHOWN	DATE: MAR 05
	CHECKED: XXX/XXX	CADD FILE NAME: rurc16440.DGN	
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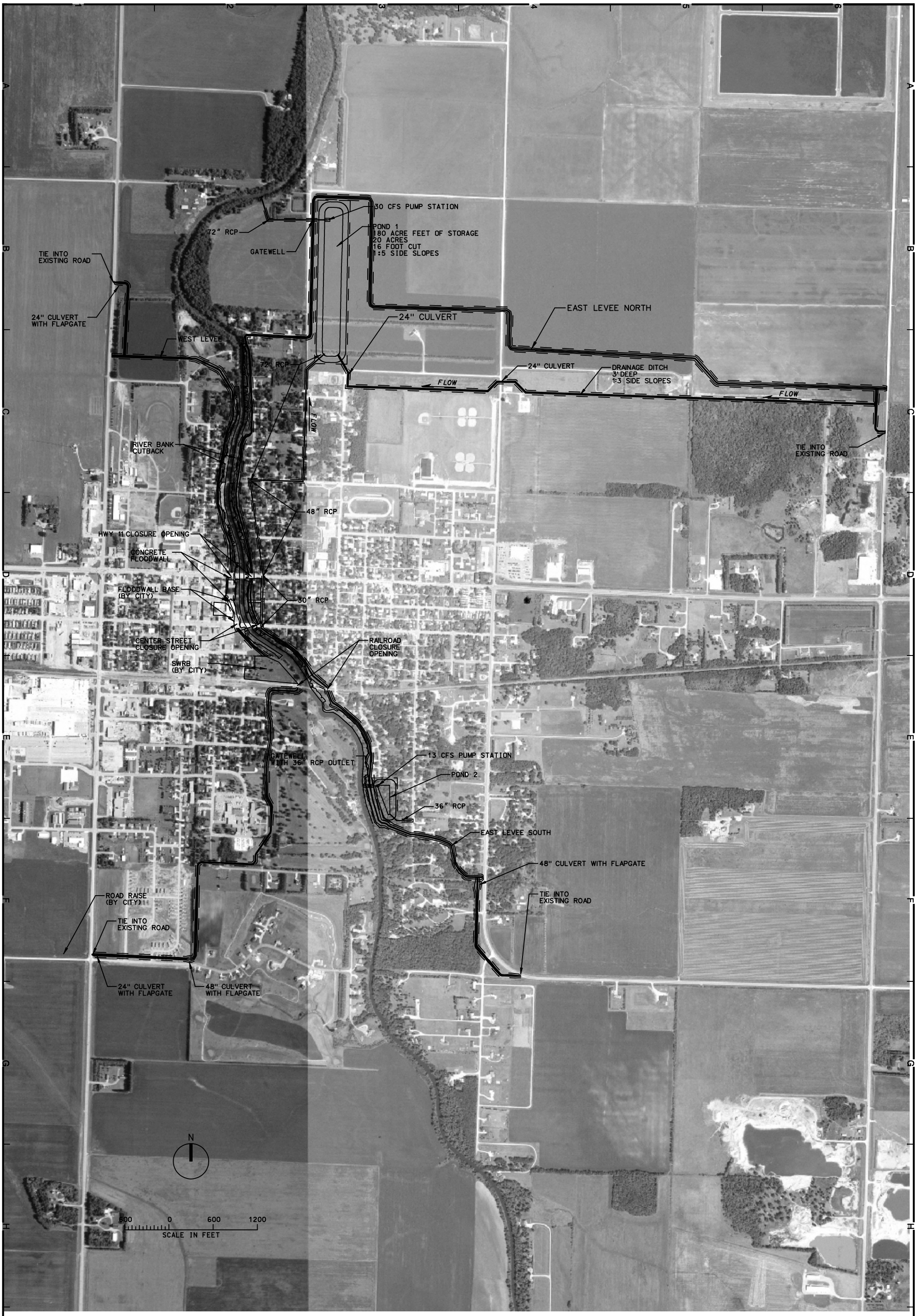
Symbol	Description	Date	Appr.

US Army Corps of Engineers
St. Paul District



DRAWING NUMBER: BASIN-T-CC/FNO.01
SHT 999 OF 999

ROSEAU FEASIBILITY STUDY
FLOOD CONTROL
500 YEAR LEVEES

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

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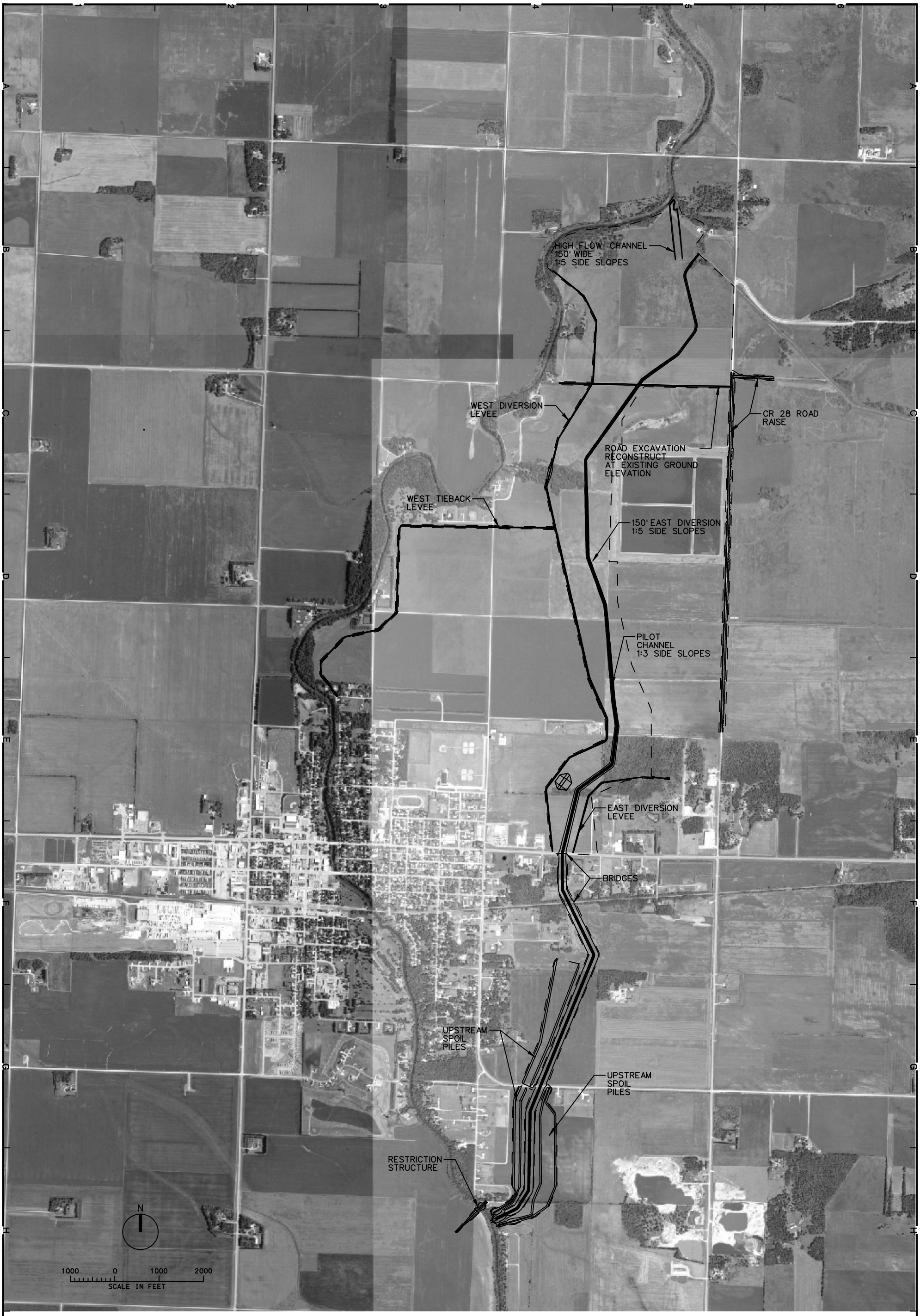
Symbol	Description	Date	Appr.

US Army Corps of Engineers
St. Paul District



SHT 999 OF 999

DRAWING NUMBER:

ROSEAU FEASIBILITY STUDY

FLOOD CONTROL

EAST DIVERSION CHANNEL
50 FOOT BOTTOM WIDTH

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

ED-D	DESIGNED: JGS/GCW	SCALE: AS SHOWN	DATE: MARCH 04
	CHECKED: XXX/XXX	CADD FILE NAME: rurc16446.DGN	
	DRAWN: GCW	SOL. NO: DACW37-01-B-0000	
ED-H	DESIGNED: SMG	AE APPROVING OFFICIAL:	
	CHECKED: XXX/XXX		

Symbol	Description	Date	Appr.

US Army Corps of Engineers
St. Paul District

DRAWING NUMBER: SHT 999 OF 999

ROSEAU FEASIBILITY STUDY

FLOOD CONTROL

EAST DIVERSION CHANNEL
150 FOOT BOTTOM WIDTH

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

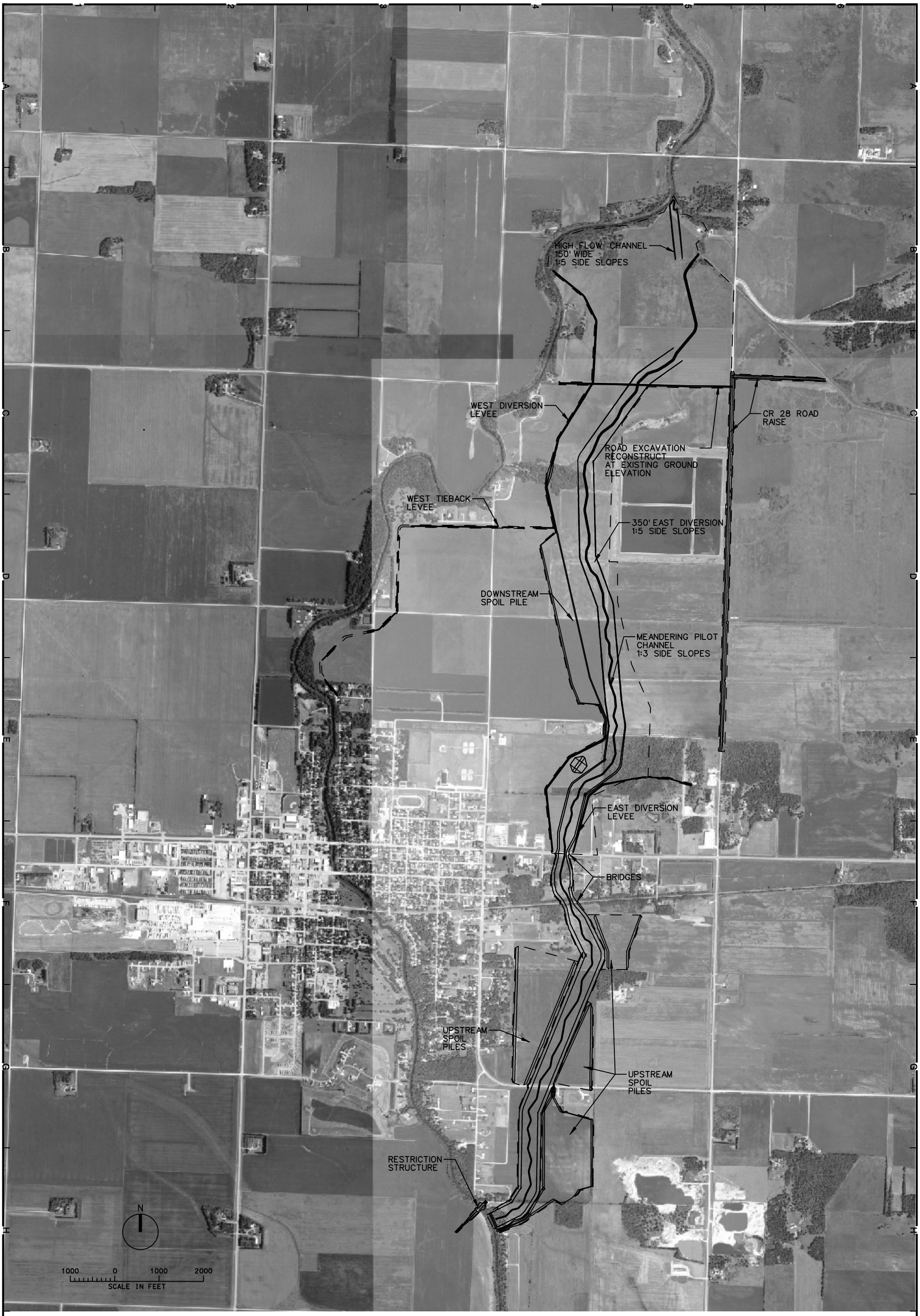
ED-D
DESIGNED: JGS/GCW
CHECKED: XXX/XXX
DRAWN: GCW

ED-H
DESIGNED: SMG
CHECKED: XXX/XXX

SCALE: AS SHOWN
DATE: MARCH 04
CADD FILE NAME: rurc16445.DGN
SOL. NO: DACW37-01-B-0000
AE APPROVING OFFICIAL:

Symbol	Description	Date	Appr.

US Army Corps of Engineers
St. Paul District



DRAWING NUMBER: SHT 999 OF 999

ROSEAU FEASIBILITY STUDY

FLOOD CONTROL

EAST DIVERSION CHANNEL
350 FOOT BOTTOM WIDTH

DEPARTMENT OF THE ARMY
ST. PAUL, MINNESOTA
CORPS OF ENGINEERS
ST. PAUL DISTRICT

ED-D	DESIGNED: JGS/GCW	SCALE: AS SHOWN	DATE: MARCH 04
	CHECKED: XXX/XXX	CADD FILE NAME: rurc16447.DGN	
	DRAWN: GCW	SOL. NO: DACW37-01-B-0000	
ED-H	DESIGNED: SMG	AE APPROVING OFFICIAL:	
	CHECKED: XXX/XXX		

Symbol	Description	Date	Appr.

US Army Corps of Engineers
St. Paul District

WORKING PAPERS

Cost Engineering

COST ESTIMATE

This summary contains the cost estimate prepared for the Feasibility Screening of Alternatives for the Roseau Flood Control Project. The estimate includes real estate, construction; planning, engineering and design, and construction management costs. The estimate for this report was developed after discussions with the design team members and a review of costs for similar construction projects. Cost comparisons from other projects were escalated to 2005 price levels.

After review of the project documents, contingencies were developed which reflect the uncertainties associated with each item. These contingencies are based on uncertainties in quantities, limited design work completed, unit pricing and items of work not defined or recognized at the time of design.

The features of this project are considered standard heavy civil works type construction that includes excavation, fill, structural concrete, bridge construction, road work, riprap, utilities relocations, topsoil and seeding.

ROSEAU FEASIBILITY STUDY

East Diversion Channel **Channel Bottom Width of 50 Feet**

Date: **24-Mar-2005**
Revised: **5-Apr-2005**

Draft Estimate for Feasibility Screening Alternatives

EC-D (JLH)

	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	CONTINGENCIES %	CONTINGENCIES AMOUNT	TOTAL AMOUNT	NOTES
01	**LANDS & DAMAGES**	1.0	LS	$1,707,380.00	$1,707,400	25%	$426,900	$2,134,300	*2,4*
TOTAL LANDS & DAMAGES					**$1,707,400**		**$426,900**	**$2,134,300**	
02	**RELOCATIONS**	1.0	LS	$200,000.00	$200,000	25%	$50,000	$250,000	*1,2,3,4*
TOTAL RELOCATIONS					**$200,000**		**$50,000**	**$250,000**	
09	**CHANNELS & CANALS**								
	EAST CHANNEL DIVERSION								
	Stripping	56,223.0	CY	$1.05	$59,000	30%	$17,700	$76,700	*2,4*
	Channel Excavation	788,036.0	CY	$2.29	$1,807,700	30%	$542,300	$2,350,000	*2,3,4*
	Inlet Structure (Earth Embankment)	2,726.0	CY	$2.24	$6,100	50%	$3,100	$9,200	*1,2,3*
	Topsoil	64,352.0	CY	$1.17	$75,500	30%	$22,700	$98,200	*2,4*
	Turf	88.6	ACRE	$999.10	$88,500	30%	$26,600	$115,100	*2,4*
	Riprap	1,205.4	TN	$26.96	$32,500	40%	$13,000	$45,500	*2,3,4*
	Geotextile	2,413.0	SY	$1.57	$3,800	40%	$1,500	$5,300	*2,3*
	Aggregate Surface (Disposal Levee)	2,557.4	TN	$15.17	$38,800	30%	$11,600	$50,400	*2,3*
	Traffic Control	1.0	LS	$18,600.00	$18,600	30%	$5,600	$24,200	*1,2,3*
	Road Raise for Bridges	1.0	LS	$192,900.00	$192,900	50%	$96,500	$289,400	*1,2,3,4*
	County 11 Bridge	1.0	LS	$520,900.00	$520,900	50%	$260,500	$781,400	*1,2,3,5*
	Weir Structure / Pedestrian Bridge	1.0	LS	$561,200.00	$561,200	50%	$280,600	$841,800	*1,2,3,5*
	Railroad Bridge	1.0	LS	$325,000.00	$325,000	50%	$162,500	$487,500	*1,2,3,5*
	CR28 Road Raise	1.0	LS	$289,600.00	$289,600	50%	$144,800	$434,400	*1,2,3,5*
	West Levee	1.0	LS	$319,000.00	$319,000	30%	$95,700	$414,700	*2,3,4*
	West Tie-back Levee	1.0	LS	$97,500.00	$97,500	30%	$29,300	$126,800	*2,3,4*
	East Levee	1.0	LS	$37,200.00	$37,200	30%	$11,200	$48,400	*2,3,4*
	Spoil Piles Upstream of Hwy 11	1.0	LS	$1,521,400.00	$1,521,400	30%	$456,400	$1,977,800	*2,3,4*
	Sled Hill	1.0	LS	$291,200.00	$291,200	30%	$87,400	$378,600	*1,2,3,4*
	SUBTOTAL EAST CHANNEL DIVERSION				**$6,286,400**		**$2,269,000**	**$8,555,400**	
TOTAL CHANNELS & CANALS					**$6,286,400**		**$2,269,000**	**$8,555,400**	
30	**PLANNING, ENGINEERING & DESIGN**	1.0	JOB	$1,320,810.00	$1,320,800	10%	$132,100	$1,452,900	*1,2*
TOTAL PLANNING, ENGINEERING & DESIGN					**$1,320,800**		**$132,100**	**$1,452,900**	
31	**CONSTRUCTION MANAGEMENT**	1.0	JOB	$616,378.00	$616,400	15%	$92,500	$708,900	*1,2*
TOTAL CONSTRUCTION MANAGEMENT					**$616,400**		**$92,500**	**$708,900**	
TOTAL PROJECT					**$10,131,000**		**$2,970,500**	**$13,101,500**	

NOTES FOR CONTINGENCIES:

1. *UNKNOWN QUANTITIES*
2. *LIMITED DESIGN WORK COMPLETED*
3. *UNKNOWN UNIT PRICES*
4. *ALIGNMENT NOT FINAL*
5. *LIMITED BORING INFORMATION AVAILABLE*

GOVERNMENT ESTIMATE WORK SHEET

25-year Levee Barrier Height

PROJECT: Roseau Flood Control Project
LOCATION: Roseau, MN
FILE: Roseau cost estimate.xls
DESIGN OPTION: 25-year Barrier Height

DATE: 24-Mar-2005

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Mobilization / Demobilization (1% total const costs)	11	1	LS	$86,063	$86,063	100%	$86,063	$172,127
Clearing and Grubbing	11	0.0	ACRE	6,700.00	$0	50%	$0	$0
Stripping	11	16,080	CY	$2.00	$32,160	35%	$11,256	$43,416
Levees: Impervious Fill	11	80,261	CY	$5.70	$457,488	35%	$160,121	$617,608
Levees: Inpsection Trench	11	30,197	LF	$8.70	$262,714	35%	$91,950	$354,664
Class V Aggregate for Levee Crown	11	5,533	CY	$21.00	$116,193	35%	$40,668	$156,861
Floodwalls: Reinforced Concrete	11	149	CY	$500.00	$74,667	35%	$26,133	$100,800
Floodwalls: Sheetpile	11	320	SF	$25.00	$8,000	35%	$2,800	$10,800
Floodwalls: Stoplog	11	0	SF	$450.00	$0	50%	$0	$0
Topsoil	11	18,988	CY	$6.25	$118,675	35%	$41,536	$160,211
Seed	11	23.5	ACRE	$1,590.00	$37,365	35%	$13,078	$50,443
Excavation	11	69,361	CY	$4.20	$291,316	50%	$145,658	$436,974
Riprap	11	15,260	CY	$39.00	$595,140	50%	$297,570	$892,710
Geotextile	11	32,954	SY	$2.76	$90,953	50%	$45,477	$136,430
Road Closures	11	0	SF	$300.00	$0	50%	$0	$0
Railroad Closures	11	0	SF	$450.00	$0	50%	$0	$0
24" RCP Culvert: North tie in with Highway 89	11	1	LS	$11,910.00	$11,910	35%	$4,169	$16,079
48" RCP Culvert: South Swale Crossing (west)	11	1	LS	$25,140.00	$25,140	35%	$8,799	$33,939
48" RCP Culvert: South Swale Crossing (east)	11	0	LS	$27,890.00	$0	35%	$0	$0
24" RCP Culvert: South tie in with Highway 89	11	0	LS	$10,730.00	$0	35%	$0	$0
Relocate 8" Santiary Line	2							
Remove existing 8" sanitary sewer	2	1,590	LF	$14.00	$22,260	35%	$7,791	$30,051
Install new 8" sanitary sewer	2							
Excavate for pipe	2	4,739	CY	$0.83	$3,933	35%	$1,377	$5,310
Install Bedding Material	2	198	CY	$11.00	$2,178	35%	$762	$2,940
Install 8" sanitary sewer	2	1,590	LF	$22.80	$36,252	35%	$12,688	$48,940
Backfill the excavation	2	4,739	CY	$0.85	$4,028	35%	$1,410	$5,438
Manual compation around sewer pipe (1/3 backfil	2	1,580	CY	$1.64	$2,591	35%	$907	$3,497
Heavy equip compact above sewer line (2/3 backf	2	3,159	CY	$0.48	$1,516	35%	$531	$2,047
Topsoil	2	511	CY	$6.25	$3,194	35%	$1,118	$4,312
Seed	2	0.6	Acre	$1,590.00	$1,002	35%	$351	$1,352
Remove existing 48" Manholes	2	7	Each	$675.00	$4,725	35%	$1,654	$6,379
Install new 48" Manholes	2	7	Each	$4,110.00	$28,770	35%	$10,070	$38,840
Install Shutoff Valves	2							

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Shutoff valve for 8" gravity sewer	2	1	Each	$1,285.00	$1,285	35%	$450	$1,735
Shutoff valve for 6" water line	2	6	Each	$1,050.00	$6,300	35%	$2,205	$8,505
Shutoff valve for 8" water line	2	2	Each	$1,285.00	$2,570	35%	$900	$3,470
Shutoff valve for 10" water line	2	3	Each	$1,610.00	$4,830	35%	$1,691	$6,521
Relocate Manhole	2							
Remove existing 48" Manholes	2	1	Each	$675.00	$675	35%	$236	$911
Install new 48" Manholes	2	1	Each	$4,110.00	$4,110	35%	$1,439	$5,549
Install Shutoff Valves	2							
Shutoff valve for 8" gravity sewer	2	2	Each	$1,285.00	$2,570	35%	$900	$3,470
Shutoff valve for 6" water line	2	2	Each	$1,050.00	$2,100	35%	$735	$2,835
Shutoff valve for 10" water line	2	2	Each	$1,610.00	$3,220	35%	$1,127	$4,347
Interior Flood Control	13							
Ponding Area 1	13							
Stripping	13	15,775	CY	$2.00	$31,550	35%	$11,043	$42,593
Excavation	13	369,727	CY	$4.20	$1,552,853	35%	$543,499	$2,096,352
Topsoil	13	10,607	CY	$6.25	$66,294	35%	$23,203	$89,497
Seed	13	19.7	Acre	$1,590.00	$31,355	35%	$10,974	$42,329
Pump Station 1	13	1	Lump Sum	$875,310.00	$875,310	35%	$306,359	$1,181,669
Gatewell 1	13	1	Lump Sum	$159,440.00	$159,440	35%	$55,804	$215,244
12" Forecmain	13	200	LF	$62.50	$12,500	35%	$4,375	$16,875
Pond 1 Storm Sewer: Center St. to Pond	13							
Demolition of Pavement	13	1,258	CY	$49.30	$62,019	35%	$21,707	$83,726
Excavaton of Aggregate for reuse	13	1,258	CY	$1.22	$1,535	35%	$537	$2,072
Excavaton of Select Granular for reuse	13	5,659	CY	$1.22	$6,904	35%	$2,416	$9,320
Excav of Aggregate unacceptable for reuse	13	1,258	CY	$4.20	$5,284	35%	$1,849	$7,133
Excav of Select Granular unacceptable for reus	13	1,886	CY	$4.20	$7,921	35%	$2,772	$10,694
Placement of reused aggregate	13	1,258	CY	$5.20	$6,542	35%	$2,290	$8,831
Placement of new aggregate	13	1,258	CY	$21.00	$26,418	35%	$9,246	$35,664
Placement of reused select granular	13	5,659	CY	$3.40	$19,241	35%	$6,734	$25,975
Placement of new select granular	13	1,886	CY	$16.00	$30,176	35%	$10,562	$40,738
Place new bituminous pavement	13	1,258	CY	$86.55	$108,880	35%	$38,108	$146,988
Excavation	13	29,239	CY	$0.83	$24,268	35%	$8,494	$32,762
Install Bedding Material	13	7,863	CY	$11.00	$86,493	35%	$30,273	$116,766
Backfill the Excavation	13	29,239	CY	$0.85	$24,853	35%	$8,699	$33,552
Manual compact around pipe (1/3 backfill)	13	9,746	CY	$1.64	$15,984	35%	$5,594	$21,578
Heavy equip compact above pipe (2/3 backfill)	13	19,493	CY	$0.48	$9,356	35%	$3,275	$12,631
Install 30" RCP	13	681	LF	$72.40	$49,304	35%	$17,257	$66,561
Install 48" RCP	13	1,319	LF	$137.90	$181,890	35%	$63,662	$245,552
Install 72" RCP	13	2,608	LF	$279.40	$728,675	35%	$255,036	$983,712
Install 72" Flared End Section	13	1	Each	$3,916.00	$3,916	35%	$1,371	$5,287
Install 72" Manhole	13	4	Each	$5,740.00	$22,960	35%	$8,036	$30,996
Install 120" Manhole	13	4	Each	$13,800.00	$55,200	35%	$19,320	$74,520

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Pond 1 Storm Sewer: Discharge Line to River	13							
Stripping	13	390	CY	$2.00	$780	35%	$273	$1,053
Excavation	13	7,167	CY	$0.83	$5,949	35%	$2,082	$8,031
Install Bedding Material	13	1,828	CY	$11.00	$20,108	35%	$7,038	$27,146
Backfill the Excavation	13	7,167	CY	$0.85	$6,092	35%	$2,132	$8,224
Manual compact around pipe (1/3 backfill)	13	2,389	CY	$1.64	$3,918	35%	$1,371	$5,289
Heavy equip compact above pipe (2/3 backfill)	13	4,778	CY	$0.48	$2,293	35%	$803	$3,096
Topsoil	13	390	CY	$6.25	$2,438	35%	$853	$3,291
Seed	13	0.5	Acre	$1,590.00	$763	35%	$267	$1,030
Install 72" RCP	13	1,128	LF	$279.40	$315,163	35%	$110,307	$425,470
Install 72" Flared End Section	13	1	Each	$3,916.00	$3,916	35%	$1,371	$5,287
Install 120" Manhole	13	1	Each	$13,800.00	$13,800	35%	$4,830	$18,630
Pond 1 Storm Sewer: Ditch from East of 11th Ave	13							
Stripping	13	2,934	CY	$2.00	$5,868	35%	$2,054	$7,922
Excavation	13	7,699	CY	$4.20	$32,336	35%	$11,318	$43,653
Topsoil	13	2,114	CY	$6.25	$13,213	35%	$4,624	$17,837
Seed	13	3.7	Acre	$1,590.00	$5,915	35%	$2,070	$7,985
24" RCP Culvert	13	2	Each	$3,480.00	$6,960	35%	$2,436	$9,396
Ponding Area 2	13							
Stripping	13	2,367	CY	$2.00	$4,734	35%	$1,657	$6,391
Excavation	13	43,809	CY	$4.20	$183,998	35%	$64,399	$248,397
Topsoil	13	1,601	CY	$6.25	$10,006	35%	$3,502	$13,508
Seed	13	3.0	Acre	$1,590.00	$4,722	35%	$1,653	$6,375
Pump Station 2	13	1	Lump Sum	$725,540.00	$725,540	35%	$253,939	$979,479
Gatewell 2	13	1	Lump Sum	$176,060.00	$176,060	35%	$61,621	$237,681
12" Forecmain	13	107	LF	$62.50	$6,688	35%	$2,341	$9,028
Pond 2 Storm Sewer: 9th Ave. to Pond	13							
Stripping	13	111	CY	$2.00	$222	35%	$78	$300
Excavation	13	2,052	CY	$0.83	$1,703	35%	$596	$2,299
Install Bedding Material	13	257	CY	$11.00	$2,827	35%	$989	$3,816
Backfill the Excavation	13	2,052	CY	$0.85	$1,744	35%	$610	$2,355
Manual compact around pipe (1/3 backfill)	13	684	CY	$1.64	$1,122	35%	$393	$1,514
Heavy equip compact above pipe (2/3 backfill)	13	1,368	CY	$0.48	$657	35%	$230	$886
Topsoil	13	111	CY	$6.25	$694	35%	$243	$937
Seed	13	0.1	Acre	$1,590.00	$223	35%	$78	$301
Install 36" RCP	13	322	LF	$95.90	$30,880	35%	$10,808	$41,688
Install 36" Flared End Section	13	1	Each	$986.00	$986	35%	$345	$1,331
Install 60" Manhole	13	1	Each	$3,980.00	$3,980	35%	$1,393	$5,373
Pond 2 Storm Sewer: Discharge Line to River	13							
Stripping	13	69	CY	$2.00	$138	35%	$48	$186
Excavation	13	1,319	CY	$0.83	$1,095	35%	$383	$1,478
Install Bedding Material	13	166	CY	$11.00	$1,826	35%	$639	$2,465
Backfill the Excavation	13	1,319	CY	$0.85	$1,121	35%	$392	$1,514
Manual compact around pipe (1/3 backfill)	13	440	CY	$1.64	$721	35%	$252	$973

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Heavy equip compact above pipe (2/3 backfill)	13	879	CY	$0.48	$422	35%	$148	$570
Topsoil	13	69	CY	$6.25	$431	35%	$151	$582
Seed	13	0.1	Acre	$1,590.00	$127	35%	$45	$172
Install 36" RCP	13	207	LF	$95.90	$19,851	35%	$6,948	$26,799
Install 36" Flared End Section	13	1	Each	$986.00	$986	35%	$345	$1,331
HTRW/Cultural/Recreation (5% total construct costs)	14/18/32	1	LS	430,317	$430,317	50%	$215,159	$645,476
TOTAL CONSTRUCTION COSTS:					$8,606,347		$3,279,322	$11,885,668
P. E. & D. (15% construction costs)	30				$1,290,952		$491,898	$1,782,850
CONSTRUCTION MGMT (10% construction costs)	31				$860,635		$327,932	$1,188,567
Lands and Damages	1				$5,831,336	25%	$1,457,834	$7,289,170
TOTAL PROJECT COSTS:					$16,589,269		$5,556,986	$22,146,255

GOVERNMENT ESTIMATE WORK SHEET

100-year Levee Barrier Height

PROJECT: Roseau Flood Control Project **DATE: 24-Mar-2005**
LOCATION: Roseau, MN
FILE: Roseau cost estimate.xls
DESIGN OPTION: 100-year Barrier Height

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Mobilization / Demobilization (1% total const costs)	11	1	LS	$97,401	$97,401	100%	$97,401	$194,801
Clearing and Grubbing	11	0.0	ACRE	6,700.00	$0	50%	$0	$0
Stripping	11	22,352	CY	$2.00	$44,704	35%	$15,646	$60,350
Levees: Impervious Fill	11	140,575	CY	$5.70	$801,278	35%	$280,447	$1,081,725
Levees: Inpsection Trench	11	34,218	LF	$8.70	$297,697	35%	$104,194	$401,890
Class V Aggregate for Levee Crown	11	6,277	CY	$21.00	$131,817	35%	$46,136	$177,953
Floodwalls: Reinforced Concrete	11	172	CY	$500.00	$86,222	35%	$30,178	$116,400
Floodwalls: Sheetpile	11	1,360	SF	$25.00	$34,000	35%	$11,900	$45,900
Floodwalls: Stoplog	11	352	SF	$450.00	$158,400	50%	$79,200	$237,600
Topsoil	11	24,847	CY	$6.25	$155,294	35%	$54,353	$209,647
Seed	11	46	ACRE	$1,590.00	$72,949	35%	$25,532	$98,481
Excavation	11	76,904	CY	$4.20	$322,997	50%	$161,498	$484,495
Riprap	11	16,452	CY	$39.00	$641,628	50%	$320,814	$962,442
Geotextile	11	35,531	SY	$2.76	$98,066	50%	$49,033	$147,098
Road Closures	11	556	SF	$300.00	$166,800	50%	$83,400	$250,200
Railroad Closures	11	222	SF	$450.00	$99,900	50%	$49,950	$149,850
24" RCP Culvert: North tie in with Highway 89	11	1	LS	$11,910.00	$11,910	35%	$4,169	$16,079
48" RCP Culvert: South Swale Crossing (west)	11	1	LS	$25,140.00	$25,140	35%	$8,799	$33,939
48" RCP Culvert: South Swale Crossing (east)	11	1	LS	$27,890.00	$27,890	35%	$9,762	$37,652
24" RCP Culvert: South tie in with Highway 89	11	1	LS	$10,730.00	$10,730	35%	$3,756	$14,486
Relocate 8" Santiary Line	2							
Remove existing 8" sanitary sewer	2	1,590	LF	$14.00	$22,260	35%	$7,791	$30,051
Install new 8" sanitary sewer	2							
Excavate for pipe	2	4,739	CY	$0.83	$3,933	35%	$1,377	$5,310
Install Bedding Material	2	198	CY	$11.00	$2,178	35%	$762	$2,940
Install 8" sanitary sewer	2	1,590	LF	$22.80	$36,252	35%	$12,688	$48,940
Backfill the excavation	2	4,739	CY	$0.85	$4,028	35%	$1,410	$5,438
Manual compation around sewer pipe (1/3 backfill)	2	1,580	CY	$1.64	$2,591	35%	$907	$3,497
Heavy equip compact above sewer line (2/3 backfill)	2	3,159	CY	$0.48	$1,516	35%	$531	$2,047
Topsoil	2	511	CY	$6.25	$3,194	35%	$1,118	$4,312
Seed	2	0.6	Acre	$1,590.00	$1,002	35%	$351	$1,352
Remove existing 48" Manholes	2	7	Each	$675.00	$4,725	35%	$1,654	$6,379
Install new 48" Manholes	2	7	Each	$4,110.00	$28,770	35%	$10,070	$38,840
Install Shutoff Valves	2							

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Shutoff valve for 8" gravity sewer	2	1	Each	$1,285.00	$1,285	35%	$450	$1,735
Shutoff valve for 6" water line	2	6	Each	$1,050.00	$6,300	35%	$2,205	$8,505
Shutoff valve for 8" water line	2	2	Each	$1,285.00	$2,570	35%	$900	$3,470
Shutoff valve for 10" water line	2	3	Each	$1,610.00	$4,830	35%	$1,691	$6,521
Relocate Manhole	2							
Remove existing 48" Manholes	2	1	Each	$675.00	$675	35%	$236	$911
Install new 48" Manholes	2	1	Each	$4,110.00	$4,110	35%	$1,439	$5,549
Install Shutoff Valves	2							
Shutoff valve for 8" gravity sewer	2	2	Each	$1,285.00	$2,570	35%	$900	$3,470
Shutoff valve for 6" water line	2	2	Each	$1,050.00	$2,100	35%	$735	$2,835
Shutoff valve for 10" water line	2	2	Each	$1,610.00	$3,220	35%	$1,127	$4,347
Interior Flood Control	13							
Ponding Area 1	13							
Stripping	13	15,775	CY	$2.00	$31,550	35%	$11,043	$42,593
Excavation	13	369,727	CY	$4.20	$1,552,853	35%	$543,499	$2,096,352
Topsoil	13	10,607	CY	$6.25	$66,294	35%	$23,203	$89,497
Seed	13	19.7	Acre	$1,590.00	$31,355	35%	$10,974	$42,329
Pump Station 1	13	1	Lump Sum	$875,310.00	$875,310	35%	$306,359	$1,181,669
Gatewell 1	13	1	Lump Sum	$159,440.00	$159,440	35%	$55,804	$215,244
12" Forecmain	13	200	LF	$62.50	$12,500	35%	$4,375	$16,875
Pond 1 Storm Sewer: Center St. to Pond	13							
Demolition of Pavement	13	1,258	CY	$49.30	$62,019	35%	$21,707	$83,726
Excavaton of Aggregate for reuse	13	1,258	CY	$1.22	$1,535	35%	$537	$2,072
Excavaton of Select Granular for reuse	13	5,659	CY	$1.22	$6,904	35%	$2,416	$9,320
Excav of Aggregate unacceptable for reuse	13	1,258	CY	$4.20	$5,284	35%	$1,849	$7,133
Excav of Select Granular unacceptable for reuse	13	1,886	CY	$4.20	$7,921	35%	$2,772	$10,694
Placement of reused aggregate	13	1,258	CY	$5.20	$6,542	35%	$2,290	$8,831
Placement of new aggregate	13	1,258	CY	$21.00	$26,418	35%	$9,246	$35,664
Placement of reused select granular	13	5,659	CY	$3.40	$19,241	35%	$6,734	$25,975
Placement of new select granular	13	1,886	CY	$16.00	$30,176	35%	$10,562	$40,738
Place new bituminous pavement	13	1,258	CY	$86.55	$108,880	35%	$38,108	$146,988
Excavation	13	29,239	CY	$0.83	$24,268	35%	$8,494	$32,762
Install Bedding Material	13	7,863	CY	$11.00	$86,493	35%	$30,273	$116,766
Backfill the Excavation	13	29,239	CY	$0.85	$24,853	35%	$8,699	$33,552
Manual compact around pipe (1/3 backfill)	13	9,746	CY	$1.64	$15,984	35%	$5,594	$21,578
Heavy equip compact above pipe (2/3 backfill)	13	19,493	CY	$0.48	$9,356	35%	$3,275	$12,631
Install 30" RCP	13	681	LF	$72.40	$49,304	35%	$17,257	$66,561
Install 48" RCP	13	1,319	LF	$137.90	$181,890	35%	$63,662	$245,552
Install 72" RCP	13	2,608	LF	$279.40	$728,675	35%	$255,036	$983,712
Install 72" Flared End Section	13	1	Each	$3,916.00	$3,916	35%	$1,371	$5,287
Install 72" Manhole	13	4	Each	$5,740.00	$22,960	35%	$8,036	$30,996
Install 120" Manhole	13	4	Each	$13,800.00	$55,200	35%	$19,320	$74,520

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Pond 1 Storm Sewer: Discharge Line to River	13							
Stripping	13	390	CY	$2.00	$780	35%	$273	$1,053
Excavation	13	7,167	CY	$0.83	$5,949	35%	$2,082	$8,031
Install Bedding Material	13	1,828	CY	$11.00	$20,108	35%	$7,038	$27,146
Backfill the Excavation	13	7,167	CY	$0.85	$6,092	35%	$2,132	$8,224
Manual compact around pipe (1/3 backfill)	13	2,389	CY	$1.64	$3,918	35%	$1,371	$5,289
Heavy equip compact above pipe (2/3 backfill)	13	4,778	CY	$0.48	$2,293	35%	$803	$3,096
Topsoil	13	390	CY	$6.25	$2,438	35%	$853	$3,291
Seed	13	0.5	Acre	$1,590.00	$763	35%	$267	$1,030
Install 72" RCP	13	1,128	LF	$279.40	$315,163	35%	$110,307	$425,470
Install 72" Flared End Section	13	1	Each	$3,916.00	$3,916	35%	$1,371	$5,287
Install 120" Manhole	13	1	Each	$13,800.00	$13,800	35%	$4,830	$18,630
Pond 1 Storm Sewer: Ditch from East of 11th Ave.	13							
Stripping	13	2,934	CY	$2.00	$5,868	35%	$2,054	$7,922
Excavation	13	7,699	CY	$4.20	$32,336	35%	$11,318	$43,653
Topsoil	13	2,114	CY	$6.25	$13,213	35%	$4,624	$17,837
Seed	13	3.7	Acre	$1,590.00	$5,915	35%	$2,070	$7,985
24" RCP Culvert	13	2	Each	$3,480.00	$6,960	35%	$2,436	$9,396
Ponding Area 2	13							
Stripping	13	2,367	CY	$2.00	$4,734	35%	$1,657	$6,391
Excavation	13	43,809	CY	$4.20	$183,998	35%	$64,399	$248,397
Topsoil	13	1,601	CY	$6.25	$10,006	35%	$3,502	$13,508
Seed	13	3.0	Acre	$1,590.00	$4,722	35%	$1,653	$6,375
Pump Station 2	13	1	Lump Sum	$725,540.00	$725,540	35%	$253,939	$979,479
Gatewell 2	13	1	Lump Sum	$176,060.00	$176,060	35%	$61,621	$237,681
12" Forecmain	13	107	LF	$62.50	$6,688	35%	$2,341	$9,028
Pond 2 Storm Sewer: 9th Ave. to Pond	13							
Stripping	13	111	CY	$2.00	$222	35%	$78	$300
Excavation	13	2,052	CY	$0.83	$1,703	35%	$596	$2,299
Install Bedding Material	13	257	CY	$11.00	$2,827	35%	$989	$3,816
Backfill the Excavation	13	2,052	CY	$0.85	$1,744	35%	$610	$2,355
Manual compact around pipe (1/3 backfill)	13	684	CY	$1.64	$1,122	35%	$393	$1,514
Heavy equip compact above pipe (2/3 backfill)	13	1,368	CY	$0.48	$657	35%	$230	$886
Topsoil	13	111	CY	$6.25	$694	35%	$243	$937
Seed	13	0.1	Acre	$1,590.00	$223	35%	$78	$301
Install 36" RCP	13	322	LF	$95.90	$30,880	35%	$10,808	$41,688
Install 36" Flared End Section	13	1	Each	$986.00	$986	35%	$345	$1,331
Install 60" Manhole	13	1	Each	$3,980.00	$3,980	35%	$1,393	$5,373
Pond 2 Storm Sewer: Discharge Line to River	13							
Stripping	13	69	CY	$2.00	$138	35%	$48	$186
Excavation	13	1,319	CY	$0.83	$1,095	35%	$383	$1,478
Install Bedding Material	13	166	CY	$11.00	$1,826	35%	$639	$2,465
Backfill the Excavation	13	1,319	CY	$0.85	$1,121	35%	$392	$1,514
Manual compact around pipe (1/3 backfill)	13	440	CY	$1.64	$721	35%	$252	$973

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Heavy equip compact above pipe (2/3 backfill)	13	879	CY	$0.48	$422	35%	$148	$570
Topsoil	13	69	CY	$6.25	$431	35%	$151	$582
Seed	13	0.1	Acre	$1,590.00	$127	35%	$45	$172
Install 36" RCP	13	207	LF	$95.90	$19,851	35%	$6,948	$26,799
Install 36" Flared End Section	13	1	Each	$986.00	$986	35%	$345	$1,331
HTRW/Cultural/Recreation (5% total construct costs)	14/18/32	1	LS	487,004	$487,004	50%	$243,502	$730,505
TOTAL CONSTRUCTION COSTS:					$9,740,070		$3,768,554	$13,508,624
P. E. & D. (15% construction costs)	30				$1,461,011		$565,283	$2,026,294
CONSTRUCTION MGMT (10% construction costs)	31				$974,007		$376,855	$1,350,862
Lands and Damages	1				$7,373,270	25%	$1,843,318	$9,216,588
TOTAL PROJECT COSTS:					$19,548,358		$6,554,010	$26,102,368

ROSEAU FEASIBILITY STUDY **Date:** **24-Mar-2005**

East Diversion Channel **Channel Bottom Width of 350 Feet** **Revised:**

Draft Estimate for Feasibility Screening Alternatives EC-D (JLH)

	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	CONTINGENCIES %	CONTINGENCIES AMOUNT	TOTAL AMOUNT	NOTES
01	**LANDS & DAMAGES**	1.0	LS	$2,043,800.00	$2,043,800	25%	$511,000	$2,554,800	*2,4*
TOTAL LANDS & DAMAGES					**$2,043,800**		**$511,000**	**$2,554,800**	
02	**RELOCATIONS**	1.0	LS	$200,000.00	$200,000	25%	$50,000	$250,000	*1,2,3,4*
TOTAL RELOCATIONS					**$200,000**		**$50,000**	**$250,000**	
09	**CHANNELS & CANALS**								
	EAST CHANNEL DIVERSION								
	Stripping	173,856.0	CY	$1.02	$178,200	30%	$53,500	$231,700	*2,4*
	Channel Excavation	2,560,837.0	CY	$2.24	$5,742,200	30%	$1,722,700	$7,464,900	*2,3,4*
	Inlet Structure (Earth Embankment)	2,726.0	CY	$2.20	$6,000	50%	$3,000	$9,000	*1,2,3*
	Topsoil	182,016.0	CY	$1.15	$208,700	30%	$62,600	$271,300	*2,4*
	Turf	234.3	ACRE	$977.12	$228,900	30%	$68,700	$297,600	*2,4*
	Riprap	1,205.4	TN	$26.38	$31,800	40%	$12,700	$44,500	*2,3,4*
	Geotextile	2,413.0	SY	$1.57	$3,800	40%	$1,500	$5,300	*2,3*
	Aggregate Surface (Disposal Levee)	3,083.7	TN	$14.85	$45,800	30%	$13,700	$59,500	*2,3*
	Traffic Control	1.0	LS	$18,200.00	$18,200	30%	$5,500	$23,700	*1,2,3*
	Road Raise for Bridges	1.0	LS	$188,500.00	$188,500	50%	$94,300	$282,800	*1,2,3,4*
	County 11 Bridge	1.0	LS	$1,781,800.00	$1,781,800	50%	$890,900	$2,672,700	*1,2,3,5*
	Weir Structure / Pedestrian Bridge	1.0	LS	$548,600.00	$548,600	50%	$274,300	$822,900	*1,2,3,5*
	Railroad Bridge	1.0	LS	$1,057,900.00	$1,057,900	50%	$529,000	$1,586,900	*1,2,3,5*
	CR28 Road Raise	1.0	LS	$573,800.00	$573,800	50%	$286,900	$860,700	*1,2,3,5*
	West Levee	1.0	LS	$469,600.00	$469,600	30%	$140,900	$610,500	*2,3,4*
	West Tie-back Levee	1.0	LS	$53,600.00	$53,600	30%	$16,100	$69,700	*2,3,4*
	East Levee	1.0	LS	$47,700.00	$47,700	30%	$14,300	$62,000	*2,3,4*
	Spoil Piles Upstream of Hwy 11	1.0	LS	$4,483,100.00	$4,483,100	30%	$1,344,900	$5,828,000	*2,3,4*
	Sled Hill	1.0	LS	$284,600.00	$284,600	30%	$85,400	$370,000	*1,2,3,4*
	SUBTOTAL EAST CHANNEL DIVERSION				**$15,952,800**		**$5,620,900**	**$21,573,700**	
TOTAL CHANNELS & CANALS					**$15,952,800**		**$5,620,900**	**$21,573,700**	
30	**PLANNING, ENGINEERING & DESIGN**	1.0	JOB	$3,273,555.00	$3,273,600	10%	$327,400	$3,601,000	*1,2*
TOTAL PLANNING, ENGINEERING & DESIGN					**$3,273,600**		**$327,400**	**$3,601,000**	
31	**CONSTRUCTION MANAGEMENT**	1.0	JOB	$1,527,659.00	$1,527,700	15%	$229,200	$1,756,900	*1,2*
TOTAL CONSTRUCTION MANAGEMENT					**$1,527,700**		**$229,200**	**$1,756,900**	
TOTAL PROJECT					**$22,997,900**		**$6,738,500**	**$29,736,400**	

NOTES FOR CONTINGENCIES:

1. *UNKNOWN QUANTITIES*
2. *LIMITED DESIGN WORK COMPLETED*
3. *UNKNOWN UNIT PRICES*
4. *ALIGNMENT NOT FINAL*
5. *LIMITED BORING INFORMATION AVAILABLE*

ROSEAU FEASIBILITY STUDY **Date: 24-Mar-2005**

East Diversion Channel **Channel Bottom Width of 150 Feet** **Revised:**

Draft Estimate for Feasibility Screening Alternatives EC-D (JLH)

	ITEM DESCRIPTION	QUANTITY	UNITS	UNIT PRICE	AMOUNT	CONTINGENCIES %	CONTINGENCIES AMOUNT	TOTAL AMOUNT	NOTES
01	**LANDS & DAMAGES**	1.0	LS	$1,823,300.00	$1,823,300	25%	$455,800	$2,279,100	*2,4*
TOTAL LANDS & DAMAGES					**$1,823,300**		**$455,800**	**$2,279,100**	
02	**RELOCATIONS**	1.0	LS	$200,000.00	$200,000	25%	$50,000	$250,000	*1,2,3,4*
TOTAL RELOCATIONS					**$200,000**		**$50,000**	**$250,000**	
09	**CHANNELS & CANALS**								
	EAST CHANNEL DIVERSION								
	Stripping	96,359.0	CY	$1.03	$99,400	30%	$29,800	$129,200	*2,4*
	Channel Excavation	1,382,873.0	CY	$2.26	$3,122,600	30%	$936,800	$4,059,400	*2,3,4*
	Inlet Structure (Earth Embankment)	2,726.0	CY	$2.20	$6,000	50%	$3,000	$9,000	*1,2,3*
	Topsoil	73,749.0	CY	$1.15	$85,100	30%	$25,500	$110,600	*2,4*
	Turf	138.4	ACRE	$983.67	$136,100	30%	$40,800	$176,900	*2,4*
	Riprap	1,205.4	TN	$26.55	$32,000	40%	$12,800	$44,800	*2,3,4*
	Geotextile	2,413.0	SY	$1.57	$3,800	40%	$1,500	$5,300	*2,3*
	Aggregate Surface (Disposal Levee)	2,732.6	TN	$14.97	$40,900	30%	$12,300	$53,200	*2,3*
	Traffic Control	1.0	LS	$18,300.00	$18,300	30%	$5,500	$23,800	*1,2,3*
	Road Raise for Bridges	1.0	LS	$189,800.00	$189,800	50%	$94,900	$284,700	*1,2,3,4*
	County 11 Bridge	1.0	LS	$1,281,700.00	$1,281,700	50%	$640,900	$1,922,600	*1,2,3,5*
	Weir Structure / Pedestrian Bridge	1.0	LS	$552,500.00	$552,500	50%	$276,300	$828,800	*1,2,3,5*
	Railroad Bridge	1.0	LS	$767,100.00	$767,100	50%	$383,600	$1,150,700	*1,2,3,5*
	CR28 Road Raise	1.0	LS	$463,500.00	$463,500	50%	$231,800	$695,300	*1,2,3,5*
	West Levee	1.0	LS	$1,076,800.00	$1,076,800	30%	$323,000	$1,399,800	*2,3,4*
	West Tie-back Levee	1.0	LS	$71,100.00	$71,100	30%	$21,300	$92,400	*2,3,4*
	East Levee	1.0	LS	$41,900.00	$41,900	30%	$12,600	$54,500	*2,3,4*
	Spoil Piles Upstream of Hwy 11	1.0	LS	$2,525,800.00	$2,525,800	30%	$757,700	$3,283,500	*2,3,4*
	Sled Hill	1.0	LS	$286,600.00	$286,600	30%	$86,000	$372,600	*1,2,3,4*
	SUBTOTAL EAST CHANNEL DIVERSION				**$10,801,000**		**$3,896,100**	**$14,697,100**	
TOTAL CHANNELS & CANALS					**$10,801,000**		**$3,896,100**	**$14,697,100**	
30	**PLANNING, ENGINEERING & DESIGN**	1.0	JOB	$2,242,065.00	$2,242,100	10%	$224,200	$2,466,300	*1,2*
TOTAL PLANNING, ENGINEERING & DESIGN					**$2,242,100**		**$224,200**	**$2,466,300**	
31	**CONSTRUCTION MANAGEMENT**	1.0	JOB	$1,046,297.00	$1,046,300	15%	$156,900	$1,203,200	*1,2*
TOTAL CONSTRUCTION MANAGEMENT					**$1,046,300**		**$156,900**	**$1,203,200**	
TOTAL PROJECT					**$16,112,700**		**$4,783,000**	**$20,895,700**	

NOTES FOR CONTINGENCIES:

1. *UNKNOWN QUANTITIES*
2. *LIMITED DESIGN WORK COMPLETED*
3. *UNKNOWN UNIT PRICES*
4. *ALIGNMENT NOT FINAL*
5. *LIMITED BORING INFORMATION AVAILABLE*

GOVERNMENT ESTIMATE WORK SHEET

500-year Levee Barrier Height

PROJECT: Roseau Flood Control Project **DATE: 24-Mar-2005**
LOCATION: Roseau, MN
FILE: Roseau cost estimate.xls
DESIGN OPTION: 500-year Barrier Height

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Mobilization / Demobilization (1% total const costs)	11	1	LS	$104,350	$104,350	100%	$104,350	$208,700
Clearing and Grubbing	11	0.0	ACRE	6,700.00	$0	50%	$0	$0
Stripping	11	26,352	CY	$2.00	$52,704	35%	$18,446	$71,150
Levees: Impervious Fill	11	191,665	CY	$5.70	$1,092,491	35%	$382,372	$1,474,862
Levees: Inpsection Trench	11	36,659	LF	$8.70	$318,933	35%	$111,627	$430,560
Class V Aggregate for Levee Crown	11	6,780	CY	$21.00	$142,380	35%	$49,833	$192,213
Floodwalls: Reinforced Concrete	11	190	CY	$500.00	$95,111	35%	$33,289	$128,400
Floodwalls: Sheetpile	11	2,160	SF	$25.00	$54,000	35%	$18,900	$72,900
Floodwalls: Stoplog	11	608	SF	$450.00	$273,600	50%	$136,800	$410,400
Topsoil	11	28,555	CY	$6.25	$178,469	35%	$62,464	$240,933
Seed	11	35.4	ACRE	$1,590.00	$56,286	35%	$19,700	$75,986
Excavation	11	76,904	CY	$4.20	$322,997	50%	$161,498	$484,495
Riprap	11	16,452	CY	$39.00	$641,628	50%	$320,814	$962,442
Geotextile	11	35,531	SY	$2.76	$98,066	50%	$49,033	$147,098
Road Closures	11	894	SF	$300.00	$268,200	50%	$134,100	$402,300
Railroad Closures	11	378	SF	$450.00	$170,100	50%	$85,050	$255,150
24" RCP Culvert: North tie in with Highway 89	11	1	LS	$11,910.00	$11,910	35%	$4,169	$16,079
48" RCP Culvert: South Swale Crossing (west)	11	1	LS	$25,140.00	$25,140	35%	$8,799	$33,939
48" RCP Culvert: South Swale Crossing (east)	11	1	LS	$27,890.00	$27,890	35%	$9,762	$37,652
24" RCP Culvert: South tie in with Highway 89	11	1	LS	$10,730.00	$10,730	35%	$3,756	$14,486
Relocate 8" Santiary Line	2							
Remove existing 8" sanitary sewer	2	1,590	LF	$14.00	$22,260	35%	$7,791	$30,051
Install new 8" sanitary sewer	2							
Excavate for pipe	2	4,739	CY	$0.83	$3,933	35%	$1,377	$5,310
Install Bedding Material	2	198	CY	$11.00	$2,178	35%	$762	$2,940
Install 8" sanitary sewer	2	1,590	LF	$22.80	$36,252	35%	$12,688	$48,940
Backfill the excavation	2	4,739	CY	$0.85	$4,028	35%	$1,410	$5,438
Manual compation around sewer pipe (1/3 backfill)	2	1,580	CY	$1.64	$2,591	35%	$907	$3,497
Heavy equip compact above sewer line (2/3 backfill)	2	3,159	CY	$0.48	$1,516	35%	$531	$2,047
Topsoil	2	511	CY	$6.25	$3,194	35%	$1,118	$4,312
Seed	2	0.6	Acre	$1,590.00	$1,002	35%	$351	$1,352
Remove existing 48" Manholes	2	7	Each	$675.00	$4,725	35%	$1,654	$6,379
Install new 48" Manholes	2	7	Each	$4,110.00	$28,770	35%	$10,070	$38,840
Install Shutoff Valves	2							

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Shutoff valve for 8" gravity sewer	2	1	Each	$1,285.00	$1,285	35%	$450	$1,735
Shutoff valve for 6" water line	2	6	Each	$1,050.00	$6,300	35%	$2,205	$8,505
Shutoff valve for 8" water line	2	2	Each	$1,285.00	$2,570	35%	$900	$3,470
Shutoff valve for 10" water line	2	3	Each	$1,610.00	$4,830	35%	$1,691	$6,521
Relocate Manhole	2							
Remove existing 48" Manholes	2	1	Each	$675.00	$675	35%	$236	$911
Install new 48" Manholes	2	1	Each	$4,110.00	$4,110	35%	$1,439	$5,549
Install Shutoff Valves	2							
Shutoff valve for 8" gravity sewer	2	2	Each	$1,285.00	$2,570	35%	$900	$3,470
Shutoff valve for 6" water line	2	2	Each	$1,050.00	$2,100	35%	$735	$2,835
Shutoff valve for 10" water line	2	2	Each	$1,610.00	$3,220	35%	$1,127	$4,347
Interior Flood Control	13							
Ponding Area 1	13							
Stripping	13	15,775	CY	$2.00	$31,550	35%	$11,043	$42,593
Excavation	13	369,727	CY	$4.20	$1,552,853	35%	$543,499	$2,096,352
Topsoil	13	10,607	CY	$6.25	$66,294	35%	$23,203	$89,497
Seed	13	19.7	Acre	$1,590.00	$31,355	35%	$10,974	$42,329
Pump Station 1	13	1	Lump Sum	$875,310.00	$875,310	35%	$306,359	$1,181,669
Gatewell 1	13	1	Lump Sum	$159,440.00	$159,440	35%	$55,804	$215,244
12" Forecmain	13	200	LF	$62.50	$12,500	35%	$4,375	$16,875
Pond 1 Storm Sewer: Center St. to Pond	13							
Demolition of Pavement	13	1,258	CY	$49.30	$62,019	35%	$21,707	$83,726
Excavaton of Aggregate for reuse	13	1,258	CY	$1.22	$1,535	35%	$537	$2,072
Excavaton of Select Granular for reuse	13	5,659	CY	$1.22	$6,904	35%	$2,416	$9,320
Excav of Aggregate unacceptable for reuse	13	1,258	CY	$4.20	$5,284	35%	$1,849	$7,133
Excav of Select Granular unacceptable for reuse	13	1,886	CY	$4.20	$7,921	35%	$2,772	$10,694
Placement of reused aggregate	13	1,258	CY	$5.20	$6,542	35%	$2,290	$8,831
Placement of new aggregate	13	1,258	CY	$21.00	$26,418	35%	$9,246	$35,664
Placement of reused select granular	13	5,659	CY	$3.40	$19,241	35%	$6,734	$25,975
Placement of new select granular	13	1,886	CY	$16.00	$30,176	35%	$10,562	$40,738
Place new bituminous pavement	13	1,258	CY	$86.55	$108,880	35%	$38,108	$146,988
Excavation	13	29,239	CY	$0.83	$24,268	35%	$8,494	$32,762
Install Bedding Material	13	7,863	CY	$11.00	$86,493	35%	$30,273	$116,766
Backfill the Excavation	13	29,239	CY	$0.85	$24,853	35%	$8,699	$33,552
Manual compact around pipe (1/3 backfill)	13	9,746	CY	$1.64	$15,984	35%	$5,594	$21,578
Heavy equip compact above pipe (2/3 backfill)	13	19,493	CY	$0.48	$9,356	35%	$3,275	$12,631
Install 30" RCP	13	681	LF	$72.40	$49,304	35%	$17,257	$66,561
Install 48" RCP	13	1,319	LF	$137.90	$181,890	35%	$63,662	$245,552
Install 72" RCP	13	2,608	LF	$279.40	$728,675	35%	$255,036	$983,712
Install 72" Flared End Section	13	1	Each	$3,916.00	$3,916	35%	$1,371	$5,287
Install 72" Manhole	13	4	Each	$5,740.00	$22,960	35%	$8,036	$30,996
Install 120" Manhole	13	4	Each	$13,800.00	$55,200	35%	$19,320	$74,520

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Pond 1 Storm Sewer: Discharge Line to River	13							
Stripping	13	390	CY	$2.00	$780	35%	$273	$1,053
Excavation	13	7,167	CY	$0.83	$5,949	35%	$2,082	$8,031
Install Bedding Material	13	1,828	CY	$11.00	$20,108	35%	$7,038	$27,146
Backfill the Excavation	13	7,167	CY	$0.85	$6,092	35%	$2,132	$8,224
Manual compact around pipe (1/3 backfill)	13	2,389	CY	$1.64	$3,918	35%	$1,371	$5,289
Heavy equip compact above pipe (2/3 backfill)	13	4,778	CY	$0.48	$2,293	35%	$803	$3,096
Topsoil	13	390	CY	$6.25	$2,438	35%	$853	$3,291
Seed	13	0.5	Acre	$1,590.00	$763	35%	$267	$1,030
Install 72" RCP	13	1,128	LF	$279.40	$315,163	35%	$110,307	$425,470
Install 72" Flared End Section	13	1	Each	$3,916.00	$3,916	35%	$1,371	$5,287
Install 120" Manhole	13	1	Each	$13,800.00	$13,800	35%	$4,830	$18,630
Pond 1 Storm Sewer: Ditch from East of 11th Ave.	13							
Stripping	13	2,934	CY	$2.00	$5,868	35%	$2,054	$7,922
Excavation	13	7,699	CY	$4.20	$32,336	35%	$11,318	$43,653
Topsoil	13	2,114	CY	$6.25	$13,213	35%	$4,624	$17,837
Seed	13	3.7	Acre	$1,590.00	$5,915	35%	$2,070	$7,985
24" RCP Culvert	13	2	Each	$3,480.00	$6,960	35%	$2,436	$9,396
Ponding Area 2	13							
Stripping	13	2,367	CY	$2.00	$4,734	35%	$1,657	$6,391
Excavation	13	43,809	CY	$4.20	$183,998	35%	$64,399	$248,397
Topsoil	13	1,601	CY	$6.25	$10,006	35%	$3,502	$13,508
Seed	13	3.0	Acre	$1,590.00	$4,722	35%	$1,653	$6,375
Pump Station 2	13	1	Lump Sum	$725,540.00	$725,540	35%	$253,939	$979,479
Gatewell 2	13	1	Lump Sum	$176,060.00	$176,060	35%	$61,621	$237,681
12" Forecmain	13	107	LF	$62.50	$6,688	35%	$2,341	$9,028
Pond 2 Storm Sewer: 9th Ave. to Pond	13							
Stripping	13	111	CY	$2.00	$222	35%	$78	$300
Excavation	13	2,052	CY	$0.83	$1,703	35%	$596	$2,299
Install Bedding Material	13	257	CY	$11.00	$2,827	35%	$989	$3,816
Backfill the Excavation	13	2,052	CY	$0.85	$1,744	35%	$610	$2,355
Manual compact around pipe (1/3 backfill)	13	684	CY	$1.64	$1,122	35%	$393	$1,514
Heavy equip compact above pipe (2/3 backfill)	13	1,368	CY	$0.48	$657	35%	$230	$886
Topsoil	13	111	CY	$6.25	$694	35%	$243	$937
Seed	13	0.1	Acre	$1,590.00	$223	35%	$78	$301
Install 36" RCP	13	322	LF	$95.90	$30,880	35%	$10,808	$41,688
Install 36" Flared End Section	13	1	Each	$986.00	$986	35%	$345	$1,331
Install 60" Manhole	13	1	Each	$3,980.00	$3,980	35%	$1,393	$5,373
Pond 2 Storm Sewer: Discharge Line to River	13							
Stripping	13	69	CY	$2.00	$138	35%	$48	$186
Excavation	13	1,319	CY	$0.83	$1,095	35%	$383	$1,478
Install Bedding Material	13	166	CY	$11.00	$1,826	35%	$639	$2,465
Backfill the Excavation	13	1,319	CY	$0.85	$1,121	35%	$392	$1,514
Manual compact around pipe (1/3 backfill)	13	440	CY	$1.64	$721	35%	$252	$973

ITEM	FEATURE CODE	QUANTITY	UNIT	UNIT PRICE	ESTIMATED AMOUNT	CONTINGENCY PERCENT	CONTINGENCY AMOUNT	TOTAL COSTS W/ CONTINGENCY
Heavy equip compact above pipe (2/3 backfill)	13	879	CY	$0.48	$422	35%	$148	$570
Topsoil	13	69	CY	$6.25	$431	35%	$151	$582
Seed	13	0.1	Acre	$1,590.00	$127	35%	$45	$172
Install 36" RCP	13	207	LF	$95.90	$19,851	35%	$6,948	$26,799
Install 36" Flared End Section	13	1	Each	$986.00	$986	35%	$345	$1,331
HTRW/Cultural/Recreation (5% total construct costs)	14/18/32	1	LS	521,749	$521,749	50%	$260,874	$782,623
TOTAL CONSTRUCTION COSTS:					$10,434,978		$4,064,521	$14,499,499
P. E. & D. (15% construction costs)	30				$1,565,247		$609,678	$2,174,925
CONSTRUCTION MGMT (10% construction costs)	31				$1,043,498		$406,452	$1,449,950
Lands and Damages	1				$8,817,000	25%	$2,204,250	$11,021,250
TOTAL PROJECT COSTS:					$21,860,723		$7,284,901	$29,145,623

Economics-Social

ROSEAU, MN ALTERNATIVES SCREENING REPORT

SUMMARY OF AVERAGE ANNUAL COSTS AND BENEFITS

Levee Alternatives

	25 Yr. Barrier	100 Yr. Barrier	500 Yr. Barrier
Total First Cost	$22,996,000	$26,952,000	$29,996,000
IDC	1,244,340	1,458,400	1,623,120
Total Investment	24,240,340	28,410,400	31,619,120
Annualized First Costs	1,405,470	1,647,252	1,833,296
Annual O&M Cost	126,478	148,236	164,978
Average Annual Charges	1,531,900	1,795,500	1,998,300
Avg. Annual Benefits			
Damage Reduction			
Residential	883,900	975,500	981,200
Commercial/Industrial/Public	363,100	1,253,500	1,317,300
Automobile	7,300	10,600	11,000
Household Temporary Relocation	83,400	93,800	94,400
Infrastructure/Emergency Response*	306,229	538,736	555,749
Flood Insurance Admin. Costs**	37,422	69,300	69,300
Advance Replacement***	38,892	42,922	43,173
Total Annual Benefits	1,720,200	2,984,400	3,072,100
Net Benefits	188,300	1,188,900	1,073,800
B/C Ratio	1.12	1.66	1.54

Assumptions:

1. Assumes a 50 year project life - 5 3/8% interest rate.
2. Assumes a 2 year period of construction.
3. Credit to existing levees - except Reach 1.
4. Annual O&M estimated as a factor of first cost. (.0055*First Cost) From Breckenridge/Wahpeton studies.

Footnotes:

* Guesstimate of frequency damage curve based on information from the 2002 flood event with damages for other events proportioned based on elevation differences between various flood events.

** Proportioned based on the percentage of damages reduced.

*** Assumes advance replacement benefits are 4.4% of the total residential average annual benefits. This is based on prior studies.

ROSEAU, MN. ALTERNATIVES SCREENING REPORT

SUMMARY OF AVERAGE ANNUAL COSTS AND BENEFITS

East Diversion Alternatives

	BW=50ft.	BW=150ft.	BW=350ft.
Total First Cost	$13,101,500	$20,900,000	$29,740,000
IDC	708,940	1,130,920	1,609,260
Total Investment	13,810,440	22,030,920	31,349,260
Annualized First Costs	800,738	1,277,366	1,817,649
Annual O&M Cost	72,058	114,950	163,570
Average Annual Charges	872,800	1,392,300	1,981,200
Avg. Annual Benefits			
Damage Reduction			
Residential	424,400	699,700	887,300
Commercial/Industrial/Public	1,083,900	1,281,500	1,319,200
Automobile	7,700	10,200	11,400
Household Temporary Reduction	52,800	76,300	88,800
Infrastructure/Emergency Response*	362,938	476,356	533,066
Flood Insurance Admin. Costs**	44,352	58,212	65,142
Advance Replacement***	- - - -	- - - -	- - - -
Total Annual Benefits	1,976,100	2,602,300	2,904,900
Net Benefits	1,103,300	1,210,000	923,700
B/C Ratio	2.26	1.87	1.47

Assumptions:

1. Assumes a 50 year project life - 5 3/8% interest rate.
2. Assumes a 2 year period of construction.
3. Credit to existing levees - except Reach 1.
4. Annual O&M estimated as a factor of first cost. (.0055*First Cost) From Breckenridge/Wahpeton studies.

Footnotes:

* Guesstimate of frequency damage curve based on information from the 2002 flood event with damages for other events proportioned based on elevation differences between various flood events.

** Proportioned based on the percentage of damages reduced.

*** Diversion plan would not involve significant utility relocations.

Hydrologic and Hydraulic

Hydraulic Design of Roseau Flood Control Project

The preliminary alternative analysis identified the Levee alternatives and the East Diversion alternatives as the most worthy of further study. HEC's FDA model was used to assess the reliability of flood stage reduction attributable to the alternatives. Three levee scenarios were studied. These levee plans offered 25-year, 100-year, and 500-year levels of protection. The HEC-FDA program was used to produce levee heights that would give a 95% level of confidence that the levees would not be overtopped for the design events.

Three variations of the diversion channel alternative were also studied. These differed in the bottom width of the diversion channel and the spans of the two bridges crossing the diversion channel. Channels with bottom widths of 50, 150, and 350 feet were studied.

Roseau Levee Design

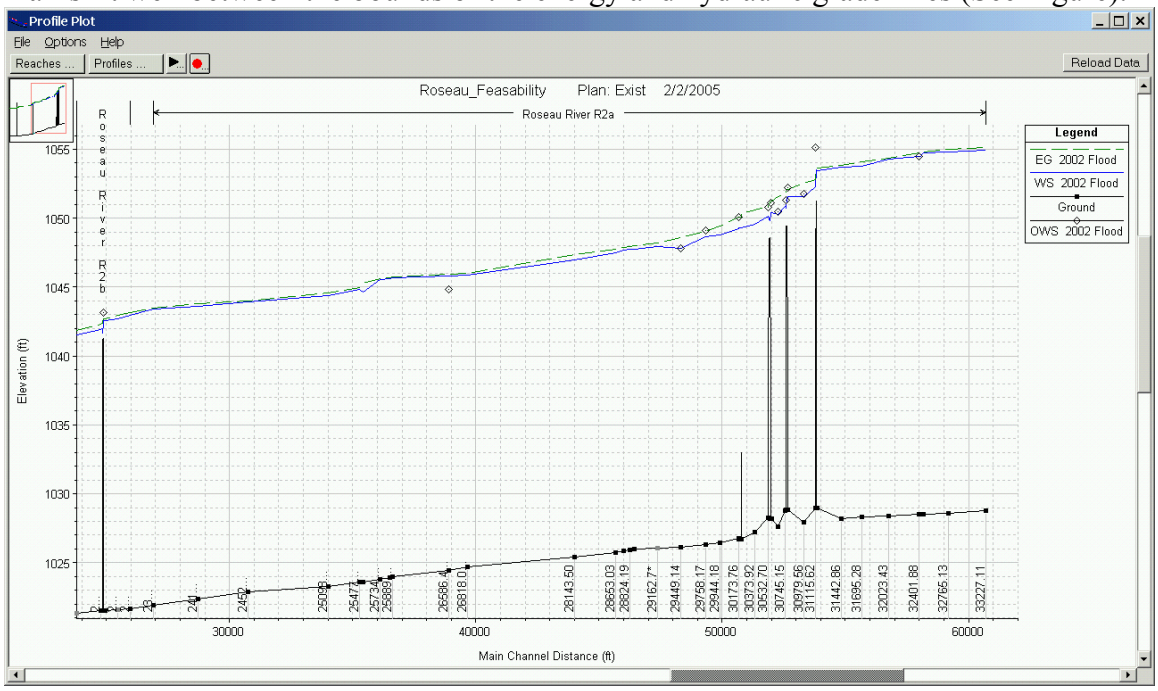
Gage data was used to produce standard deviation for the water surface. The Malung gage is about three miles upstream of Roseau. The Roseau Gage is located on the Center Street Bridge in downtown Roseau.

> The Malung Gage showed a standard deviation of 2.11 feet based on discharge measurements. The standard deviation rises to 3.33 feet when only the discharges above 2000 cfs are analyzed. A standard deviation of 2.30 based on annual peak stages based on discharge. This data is not used in the analysis.
>
> The Center Street gage in Roseau showed 0.74 feet standard deviation in the water surface elevation based on
> discharge measurements. This standard deviation was chosen to be most representative for the Roseau levee reach.

Manning coefficients were adjusted +- 16 percent to produce profiles that had 0.76 feet difference at the Center Street gage for the 100-year discharge. These water surface profiles were used to estimate the standard deviation at other locations along the levee alignment. The standard deviations ranged from 0.25 at the downstream end of town to 0.9 feet at the upstream end. A minimum of 0.5 feet standard deviation was applied to the downstream cross sections.

The FDA model was used to determine 'point' levee heights that would produce a 95 percent confidence of containing the 100-year flood. The energy grade line data for the 'with levee condition' geometry was used to produce the rating curves used in the FDA model. The levee profiles are therefore based on the energy grade line.

The energy grade line was chosen for design because the high water mark data indicated that in many locations the energy grade could be a good predictor of the high water elevations in the channel margins. The existing condition HEC-RAS model was calibrated by matching the high water marks for the 2002 flood to both the HGL and EGL, and the hydraulic grade rating curve at the Center Street gage. The high water marks fit well between the bounds of the energy and hydraulic grade lines (See Figure).



At the very far downstream end of town, the levee tieback elevation was given a minimum elevation of 2 feet above the 100yr water surface elevation. Generally, the 95% reliability levee profile followed the base levee geometry 1000-year profile.

Supperiority was next added to the 95% levee profile. The Manning adjustment factors was modified (increased 12%) to show this 0.5 foot increase in energy grade line at the upstream end of the levee for the 1000-year profile. This profile also showed a 0.5-foot increase just below the railroad bridge.

Another profile was produced using the base levee geometry with the addition of 5 feet of debris plugging the full width of the railroad bridge. This resulting profile was about 0.9 feet higher than the base profile upstream of the railroad. The adopted superiority levee profile for the reach downstream of the railroad bridge was taken to be the 0 to 0.5 foot increase (1000-year) from the high manning coefficient profile.

Upstream of the railroad bridge the 1000-year profile with the railroad plugging scenario was used for the superiority profile. This revised superiority profile was used to produce the levee point elevations in the FDA model. Very minor adjustments to the new levee elevations was made to cross sections 28653.03 and 29449.14 to insure that the 95% reliability was maintained

The Minnesota DNR criteria of containing the 500yr water surface profile (and energy grade) within the levee is met for the 100yr levee design. . The following table includes the comparable assumptions used to produce the 25-year and 500-year levee designs.

==========

25yr Levee

Downstream of RR Bridge: Based on profile of 100yr profile (discharge=10860cfs) steepened through reach by increasing Manning Coefficient.

Upstream of RR Bridge: RR debris plugging was used for superiority. The EGL profiles for the steepened Manning run and the plugging run were very similar about 0.1 feet difference.

100yr Levee

Below RR Bridge: Based on profile of 1000yr profile (discharge=16,200cfs) Steepened through reach by increasing Manning Coefficient.

Upstream of RR Bridge: RR debris plugging was used for superiority.

500yr Levee

Downstream of RR Bridge: Based on profile of 18100cfs steepened through reach by increasing Manning Coefficient.

Upstream of RR Bridge: RR debris plugging was used for superiority.

==========

Table of Levee Profile Assumptions

The following tables show the resulting output from the FDA model using the adopted levee profile.

Roseau2 Project Performance
by Damage Reaches for the 25yr Levee
(25yr Levee) plan for Analysis Year 2004
(Stages in ft.)
Plan was calculated with Uncertainty

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedar Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expecte	10	25	50	10%	4%	2%	1%	.4%	.2%
Roseau Riv	City of Rose	TrtPlnt_2658	Nr.Treatment Pla	levee	0.0010	0.0060	0.0565	0.1353	0.2522	0.9987	0.9601	0.9027	0.8433	0.7562	0.6798
		XS 28653	XS 28653	levee	0.0050	0.0110	0.1091	0.2509	0.4388	0.9996	0.9508	0.8030	0.6227	0.4075	0.2648
		DS end 294	DS end of Town	levee	0.0070	0.0120	0.1160	0.2653	0.4602	0.9997	0.9506	0.7868	0.5847	0.3580	0.2200
		DS_Hwy11 3	XS 30203.8	levee	0.0040	0.0090	0.0830	0.1948	0.3516	1.0000	0.9865	0.8930	0.7007	0.4058	0.2143
		Section 305	XS 30532	levee	0.0040	0.0080	0.0747	0.1765	0.3219	1.0000	0.9901	0.9145	0.7408	0.4453	0.2410
		Hwy11Up 30	Hwy11 Upstrean	levee	0.0030	0.0080	0.0760	0.1794	0.3266	1.0000	0.9815	0.8945	0.7473	0.5062	0.3201
		CenterSt_D	Center St XS 307	levee	0.0030	0.0080	0.0748	0.1767	0.3221	1.0000	0.9821	0.8968	0.7527	0.5150	0.3286
		RR_HWY11	XS 30781.33	levee	0.0030	0.0080	0.0736	0.1740	0.3178	1.0000	0.9864	0.9083	0.7533	0.4856	0.2849
		RR_DN XS 3	RR_DN XS 3111	levee	0.0040	0.0080	0.0733	0.1734	0.3167	1.0000	0.9902	0.9211	0.7519	0.4384	0.2276
		RR_UP XS 3	RR_UP XS 3114	levee	0.0040	0.0070	0.0700	0.1660	0.3044	1.0000	0.9941	0.9369	0.7645	0.4310	0.2156
		US_of_RR_3	XS 31442.86	levee	0.0040	0.0080	0.0734	0.1735	0.3168	1.0000	0.9926	0.9293	0.7474	0.4127	0.2060
		US End 324	US end of Rose	levee	0.0050	0.0080	0.0800	0.1882	0.3410	1.0000	0.9913	0.9174	0.7109	0.3629	0.1708

****** - Computations have not been completed.
\+ - Something has changed and computations need to be redone.

HEC-FDA results for 25-year Levee Design

Roseau2 Project Performance
by Damage Reaches for the 100yr_levee
(100yr levee) plan for Analysis Year 2004
(Stages in ft.)
Plan was calculated with Uncertainty

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedar Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expecte	10	25	50	10%	4%	2%	1%	.4%	.2%
Roseau Riv	City of Rose	TrtPlnt_2658	Nr.Treatment Pla	levee	0.0010	0.0010	0.0090	0.0223	0.0441	0.9999	0.9963	0.9881	0.9764	0.9512	0.9234
		XS 28653	XS 28653	levee	0.0010	0.0030	0.0262	0.0642	0.1243	1.0000	0.9982	0.9868	0.9560	0.8659	0.7610
		DS end 294	DS end of Town	levee	0.0010	0.0030	0.0269	0.0660	0.1276	1.0000	0.9984	0.9869	0.9533	0.8528	0.7379
		DS_Hwy11 3	XS 30203.8	levee	0.0010	0.0020	0.0163	0.0402	0.0787	1.0000	1.0000	0.9995	0.9948	0.9543	0.8770
		Section 305	XS 30532	levee	0.0010	0.0020	0.0156	0.0385	0.0756	1.0000	1.0000	0.9997	0.9963	0.9643	0.8992
		Hwy11Up 30	Hwy11 Upstrean	levee	0.0010	0.0020	0.0175	0.0432	0.0846	1.0000	0.9999	0.9982	0.9898	0.9431	0.8654
		CenterSt_D	Center St XS 307	levee	0.0010	0.0020	0.0174	0.0428	0.0838	1.0000	0.9999	0.9983	0.9902	0.9451	0.8701
		RR_HWY11	XS 30781.33	levee	0.0010	0.0020	0.0161	0.0398	0.0780	1.0000	1.0000	0.9994	0.9948	0.9578	0.8885
		RR_DN XS	RR_DN XS 3111	levee	0.0010	0.0020	0.0153	0.0379	0.0744	1.0000	1.0000	0.9998	0.9971	0.9674	0.9063
		RR_UP XS 3	RR_UP XS 3114	levee	0.0010	0.0010	0.0146	0.0362	0.0711	1.0000	1.0000	0.9999	0.9985	0.9799	0.9420
		US_of_RR_	XS 31442.86	levee	0.0010	0.0020	0.0149	0.0369	0.0724	1.0000	1.0000	0.9999	0.9980	0.9754	0.9310
		US End 324	US end of Rose	levee	0.0010	0.0020	0.0158	0.0390	0.0765	1.0000	1.0000	0.9998	0.9959	0.9626	0.8998

***** - Computations have not been completed.
* - Something has changed and computations need to be redone.

HEC-FDA results for 100-year Levee Design

Roseau2 Project Performance
by Damage Reaches for the 500-yr Levee
(500-yr Levee) plan for Analysis Year 2004
(Stages in ft.)
Plan was calculated with Uncertainty

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedar Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expecte	10	25	50	10%	4%	2%	1%	.4%	.2%
Roseau Riv	City of Rose	TrtPlnt_2658	Nr.Treatment Pla	levee	0.0010	0.0000	0.0049	0.0121	0.0241	1.0000	0.9989	0.9959	0.9911	0.9795	0.9655
		XS 28653	XS 28653	levee	0.0010	0.0020	0.0149	0.0369	0.0724	1.0000	0.9999	0.9992	0.9963	0.9815	0.9568
		DS end 294	DS end of Town	levee	0.0010	0.0010	0.0148	0.0366	0.0719	1.0000	0.9999	0.9994	0.9968	0.9824	0.9577
		DS_Hwy11 3	XS 30203.8	levee	0.0010	0.0010	0.0138	0.0341	0.0669	1.0000	1.0000	1.0000	0.9997	0.9965	0.9894
		Section 305	XS 30532	levee	0.0010	0.0010	0.0137	0.0339	0.0666	1.0000	1.0000	1.0000	0.9998	0.9981	0.9940
		Hwy11Up 30	Hwy11 Upstream	levee	0.0010	0.0010	0.0139	0.0345	0.0678	1.0000	0.9999	0.9999	0.9994	0.9934	0.9830
		CenterSt_D	Center St XS 307	levee	0.0010	0.0010	0.0139	0.0345	0.0677	1.0000	0.9999	0.9999	0.9994	0.9940	0.9840
		RR_HWY11	XS 30781.33	levee	0.0010	0.0010	0.0138	0.0340	0.0669	1.0000	1.0000	1.0000	0.9997	0.9969	0.9907
		RR_DN XS	RR_DN XS 3111	levee	0.0010	0.0010	0.0137	0.0338	0.0665	1.0000	1.0000	1.0000	0.9998	0.9983	0.9946
		RR_UP XS	RR_UP XS 3114	levee	0.0010	0.0010	0.0137	0.0338	0.0665	1.0000	1.0000	1.0000	0.9999	0.9986	0.9954
		US_of_RR_	XS 31442.86	levee	0.0010	0.0010	0.0137	0.0339	0.0666	1.0000	1.0000	1.0000	0.9998	0.9979	0.9935
		US End 324	US end of Rose	levee	0.0010	0.0010	0.0138	0.0341	0.0670	1.0000	1.0000	1.0000	0.9998	0.9966	0.9899

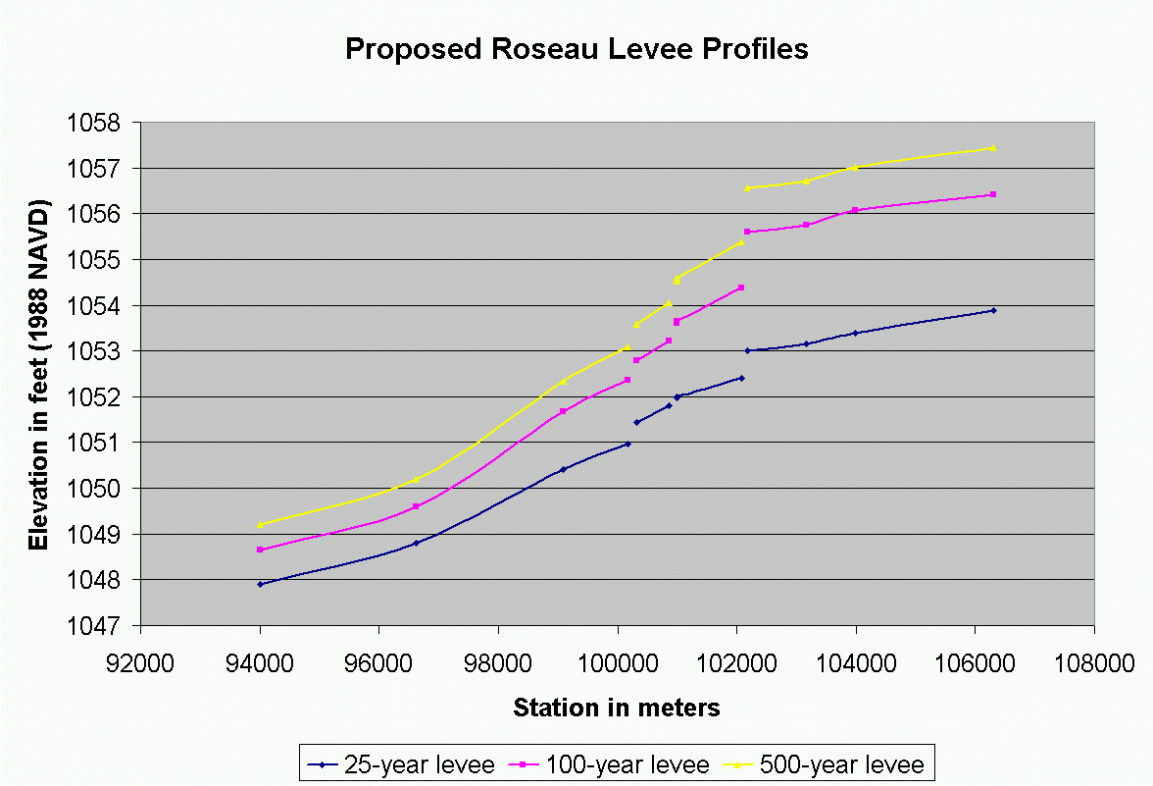
****** - Computations have not been completed.
\+ - Something has changed and computations need to be redone.

HEC-FDA results for 500-year Levee Design

The following table and figure show the top of barrier profile elevations for the three levee designs.

Cross Section	25-Year Levee Elev	100-Year Levee Elev	500-Year Lev. El
32401.88	1053.89	1056.42	1057.45
31695.28	1053.40	1056.08	1057.01
31442.86	1053.15	1055.75	1056.72
31143.71	1053.01	1055.59	1056.56
31130 Railroad Bridge			
31115.62	1052.41	1054.38	1055.38
30783.19	1052.00	1053.65	1054.58
30781.33	1051.97	1053.60	1054.53
30766 Center Street Bridge			
30745.15	1051.80	1053.21	1054.06
30576.61	1051.44	1052.78	1053.58
30555 Highway 11 Bridge			
30532.70	1050.97	1052.35	1053.10
30203.80	1050.40	1051.67	1052.33
30190.39 Dam			
29449.14	1048.80	1049.60	1050.2
28653.03	1047.90	1048.65	1049.2

Table of Roseau Levee Top of Barrier Elevations



Top of Barrier Profiles

Interior Drainage for Levee Plans

The interior drainage preliminary design for the east side of town is discussed in Barr Engineering's "Preliminary East Side Concept Stormwater Plan, Roseau, Minnesota, April 28, 2004". This report proposes ponding areas in combination with supplemental storm sewer construction to solve the interior drainage issues

Barr Engineering is also in the process designing an interior drainage system for the west side of the river. This system includes interceptor storm sewers, a detention pond, and pumping station.

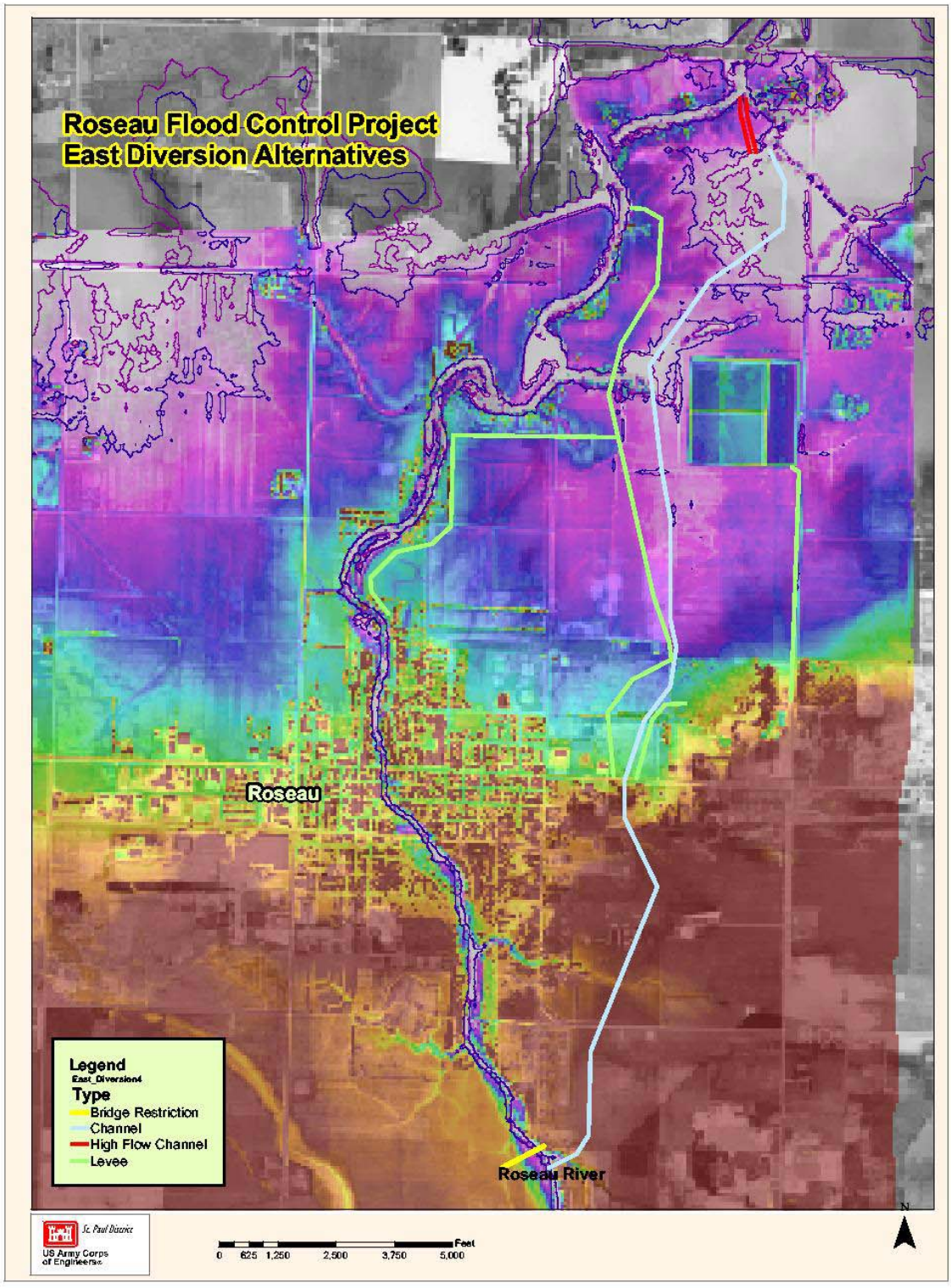
Roseau East Diversion Channel Design

Channel Grade

Three alternative channel bottom widths of 50, 150, and 350 feet were chosen for sensitivity analysis. The entrance to the East Diversion channel is set at an elevation of 1042.0 feet. This is roughly equivalent to the existing 2-year water surface profile. This is taken to be the channel forming discharge. This water surface elevation seems reasonable when looking at model cross section in this reach between Malung and Roseau. Side channel deposits can often be seen in the sections at or very near this profile elevation. It is hoped that the diversion alternative will have very little effect on the geomorphology and will not have a noticeable impact on sediment deposition in the main river channel below the start of the diversion channel.

The preliminary analysis of East Diversion alternatives showed that minimizing the excavation to the north of town could significantly decrease the cost of the channel. This cost was minimized by utilizing more floodplain conveyance (north of Highway 11) in place of excavated channel.

The channel invert drops 2 feet on a slope of 0.000256 from the channel entrance to the first bridge (Railroad Bridge). The channel bottom is horizontal from this location to Hay Creek at its confluence with the Roseau River. Upstream of Highway 11, the channel cuts about 15 feet below the existing ground. Channels deeper than 15 feet were discouraged because of adverse geotechnical factors. The land elevations drop quickly to the north (downstream) of Highway 11. From this point to the north the channel cut becomes increasingly shallow as the land elevations drop closer to the channel invert elevation. The flow increasingly transitions from flow in a channel to overland floodplain flow conditions. A 1000-foot floodplain corridor has been identified north of Highway 11 as a component of the conveyant area of this diversion alternative.


Roseau Flood Control Project
East Diversion Alternatives
Roseau
Roseau River
Legend
East_Diversion4
Type
Bridge Restriction
Channel
High Flow Channel
Levee
St. Paul District
US Army Corps of Engineers
0 625 1,250 2,500 3,750 5,000
Feet
N

Bridges

Two bridges are proposed across the diversion channel. These bridges are for the railroad and Highway 11. For the 50, 150, and 350-foot bottom width alternatives, the bridges will span 100, 125, and 175 feet respectively with one central pier. Minimum high cord elevations for the bridges are 1052.5 for the railroad, and 1052.0 for the Highway 11 Bridge. These bridge sizes produce velocities ranging from of 4.5 and 4.9 for the 100-year flood and 5.7 and 6.6 feet per second for the 95% confidence 100yr flood.

High Flow Return Channel

The diversion channel empties into Hay Creek at the northern end of the project. The channel through Hay Creek can handle a portion of the flood flows without serious erosion. An additional high flow channel will have to be constructed in parallel to the Hay Creek channel to provide supplemental conveyance. This channel will be sized to convey enough discharge to provide acceptable velocities in Hay Creek.

Roseau River Restriction Bridge

It was found that the diversion caused a significant drop in water surface in the Roseau River at the channel inlet. This produced low velocities within the channel. This could cause problems with sediment deposition. It also meant that the costly channel excavation was not being well utilized by the project design. The remedy was to add a restrictive element to the Roseau River channel. This restriction will increase the energy available to drive water through the diversion channel. This restriction will be located on the main Roseau River channel just below the inlet to the diversion channel. The currently envisioned restriction would be similar to a roadway bridge abutment with a 3.5 ft wide bridge deck. The flanks of the restriction would extend across the valley at elevation 1053.5. The gap left by the opening would have a width of 45 feet and a bottom elevation of 1030.0. This gap extends 50 feet from the upstream to downstream ends. The 45-foot span is similar to the railroad bridge located largest span of the further downstream. The following table shows the velocities that would be expected by the 100-year and 100-year (95% confidence) flooding condition. Additional design effort will be necessary to insure that erosive forces are controlled at this structure.

Diversion Bottom Width	Restriction 100yr Velocity	Restriction 100yr (95%) Velocity
50	7.8	9.9
150	6.9	8.4
350	6.1	7.0

Velocities through Restriction

Diversion Levees

A diversion levee will be included along the left bank of the diversion channel. It will run roughly 1.5 miles to the north. The purpose of the levee is to prevent diversion waters from flooding the northeast part of Roseau.

A tieback levee will roughly follow the river from town to the diversion levee. This levee gives protection to the lower east side of town from backwater flooding from the main channel of the Roseau River.
The diversion levee is extended another mile to the north for the 150, and 350-foot bottom width channel alternatives. Without the extended levee, much of the large diversion flows would flow back toward the main river channel. This discharge would flow past flooded homes at higher velocities than exist presently. The direction of flow would be toward the main river channel as opposed to parallel to or away from the river channel under existing conditions.

This northern levee segment is not a component of the 50-foot diversion plan. This is because of the smaller amount of river flow being diverted by the smaller channel. In this case, it is better to allow some of the river flow to break out to the east and share the diversion corridor conveyance.

Reliability of Diversion Levee and Town Reaches

The FDA model was also used to determine how reliably the diversion plans would protect the City of Roseau. Stage uncertainties developed for the levee alternatives was also used for the diversion channel alternatives. Discharge frequency curves were generated within HEC-FDA based on the 2, 10, 50, 100, 200, 500, and 1000-year discharges obtained from the HEC-RAS diversion channel optimization. This was done for the town reach of the Roseau River (including the tie back levee) as well as for the diversion channel side levee design.

In the river reach through town, the gage rating curve and standard deviation of stage will be used as before for the levee alternatives. The standard deviation for stages along the diversion channel was not readily available. The standard deviation in stages was assumed to be half of the span between two water surface profiles. These profiles were produced by making assumptions chosen to maximize and minimize the stages in the East Diversion channel. The following assumptions were made to produce three diversion profiles (the ‘high’ and ‘low’ diversion conditions, and another profile produced using ‘normal’ assumptions.

Maximize Diversion Channel Stages Model

a. **Bridge Routines to model Restriction using energy and momentum methods. (Contraction/Expansion Coefficient 0.6/0.8)**

b. **High Manning in Diversion (channel n=0.035 for short grass; overland areas for "Heavy Stand of Timber, few don trees, little undergrowth, flow into branches" n=0.070)**
c. Existing Manning through town
d. New optimized discharge/frequency curve
e. Same stage/discharge rating curves with same SD as levee alts.

Normal Diversion Channel Stages Model
f. a. Bridge Routines to model Restriction using energy and momentum methods (Contraction/Expansion Coefficient 0.3/0.5)
g. **Normal Manning in Diversion (channel n=0.030 for short grass; overland areas for "Heavy Stand of Timber, few don trees, little undergrowth, flow into branches" n=0.120)**
h. Existing Manning through town
i. New optimized discharge/frequency curve
j. Same stage/discharge rating curves with same SD as levee alts.

Minimize Diversion Channel Stages Model
k. a. **Bridge Routines to model Restriction using energy and momentum methods (Contraction/Expansion 0.1/0.3)**
l. **High Manning in Diversion (channel n=0.025 for short grass; overland areas for "Heavy Stand of Timber, few down trees, little undergrowth, flow into branches" n=0.160)**
m. Existing Manning through town
n. New optimized discharge/frequency curve
o. Same stage/discharge rating curves with same SD as levee alts.

The 'Normal' model was used to give the base rating curves to the FDA program. The stage difference between the 'Maximum Diversion Stage' and 'Minimum Diversion Stage' models (100-year flood) was used as two standard deviations for stage.

The following table contains the levee elevations that provided a 95% reliability of non-exceedance for the 100-year flood. Additional superiority was not added along these levees because the levees are adjacent to the lowest areas within the protected area. These levees are all located essentially at the downstream end of Roseau.

Reach	Location	Section	E.Diversion 350ft BW	E.Diversion 150ft BW	E.Diversion 50ft BW
EAST Diversion Channel Levee	D.S. end	733	1046.5	1045.6	

	Treatment Plant	1845	1048.3	1047.7	
		3049	1049.5	1049.1	1048
	Hwy11	4415	1050.9	1050.9	1050.9
Roseau Channel Tie Back Levee	nr. Treatment Plt.	26586	1045.4	1046.3	1046.9
		28653	1046.7	1047.7	1048.3
	D.S. end of Twn	29449	1047.4	1048.5	1049.1

Table of East Diversion Levee Elevations

The following tables show the FDA Results for the East Diversion Levee designs. The East Diversion levees are defined at cross sections 733, 1845, 3048, and 4415. The tie back levee cross sections are 26586, 28653, and 29449.

Roseau2 Project Performance
by Damage Reaches for the EDiv 50ft
(East Diversion 50ft BW) plan for Analysis Year 2004
(Stages in ft.)
Plan was calculated with Uncertainty

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedar Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expecte	10	25	50	10%	4%	2%	1%	.4%	.2%
Roseau River	City of Roseau	TrtPlnt_26586.4	Nr.Treatment Plant XS 26586	levee	0.0010	0.0010	0.0117	0.0290	0.0571	0.9999	0.9990	0.9886	0.9578	0.8900	0.8278
		XS 28653	XS 28653	levee	0.0010	0.0030	0.0250	0.0613	0.1189	1.0000	0.9994	0.9872	0.9500	0.8561	0.7531
		DS end 29449	DS end of Town XS 29449	levee	0.0010	0.0030	0.0252	0.0617	0.1196	1.0000	0.9995	0.9876	0.9506	0.8546	0.7424
		DS_Hwy11 30203.8	XS 30203.8	levee	0.0240	0.0290	0.2528	0.5174	0.7671	0.9928	0.7579	0.4086	0.1878	0.0600	0.0228
		Section 30532	XS 30532	levee	0.0080	0.0120	0.1108	0.2543	0.4440	1.0000	0.9693	0.8106	0.5751	0.3093	0.1636
		Hwy11Up 30576	Hwy11 Upstream Section 30576	levee	0.0220	0.0280	0.2448	0.5043	0.7543	0.9896	0.7736	0.4466	0.2221	0.0801	0.0325
		CenterSt_D 30745	Center St XS 30745	levee	0.0210	0.0260	0.2318	0.4828	0.7325	0.9927	0.7986	0.4758	0.2416	0.0890	0.0364
		RR_HWY11_30781	XS 30781.33	levee	0.0210	0.0270	0.2360	0.4898	0.7397	0.9922	0.7915	0.4614	0.2311	0.0829	0.0335
		RR_DN XS 31115	RR_DN XS 31115	levee	0.0020	0.0040	0.0389	0.0944	0.1800	1.0000	0.9987	0.9780	0.9085	0.7381	0.5570
		RR_UP XS 31143	RR_UP XS 31143	levee	0.0030	0.0060	0.0544	0.1306	0.2441	1.0000	0.9955	0.9489	0.8326	0.6063	0.4166
		US_of_RR_31442	XS 31442.86	levee	0.0040	0.0070	0.0719	0.1702	0.3114	1.0000	0.9885	0.9122	0.7543	0.5004	0.3185
		US End 32401	US end of Roseau XS 32401	levee	0.0020	0.0040	0.0438	0.1059	0.2007	1.0000	0.9978	0.9670	0.8800	0.6884	0.5039
E_Div_150ft	East Diversion 150ft BW	ED150 XS 733	ED150 XS 733	levee	0.0010	0.0030	0.0287	0.0701	0.1354	0.9898	0.9732	0.9626	0.9550	0.9467	0.9416
		ED150_XS_1845	ED150 XS 1845	levee	0.0010	0.0010	0.0099	0.0246	0.0486	0.9999	0.9976	0.9866	0.9592	0.9156	0.8888
		ED150 XS 3049	ED150 XS 3049	levee	0.0010	0.0010	0.0076	0.0189	0.0375	1.0000	0.9990	0.9914	0.9675	0.9251	0.8974
		ED150 XS 4415	ED150 XS 4415	levee	0.0010	0.0010	0.0091	0.0226	0.0447	0.9999	0.9993	0.9922	0.9637	0.9049	0.8627

****** - Computations have not been completed.
\+ - Something has changed and computations need to be redone.

HEC-FDA Results for 50 foot Bottom Width East Diversion Alternative

Roseau2 Project Performance
by Damage Reaches for the EDiv150ft_BW
(East Diversion 150ft bottom width channel) plan for Analysis Year 2004
(Stages in ft.)
Plan was calculated with Uncertainty

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedar Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expecte	10	25	50	10%	4%	2%	1%	.4%	.2%
Roseau River	City of Roseau	TrtPlnt_26586.4	Nr.Treatment Plant XS 26586	levee	0.0010	0.0010	0.0135	0.0334	0.0656	1.0000	0.9994	0.9909	0.9548	0.8836	0.8051
		XS 28653	XS 28653	levee	0.0010	0.0020	0.0219	0.0537	0.1046	1.0000	0.9999	0.9929	0.9568	0.8840	0.7967
		DS end 29449	DS end of Town XS 29449	levee	0.0010	0.0020	0.0210	0.0518	0.1009	1.0000	0.9999	0.9940	0.9608	0.8899	0.8035
		DS_Hwy11 30203.8	XS 30203.8	levee	0.0070	0.0110	0.1087	0.2500	0.4375	1.0000	0.9678	0.8159	0.5701	0.3567	0.2273
		Section 30532	XS 30532	levee	0.0010	0.0040	0.0361	0.0878	0.1680	1.0000	0.9995	0.9790	0.8980	0.7520	0.6109
		Hwy11Up 30576	Hwy11 Upstream Section 30576	levee	0.0060	0.0110	0.1051	0.2425	0.4261	0.9999	0.9643	0.8248	0.6013	0.3939	0.2634
		CenterSt_D 30745	Center St XS 30745	levee	0.0060	0.0100	0.0973	0.2257	0.4005	1.0000	0.9713	0.8471	0.6290	0.4183	0.2840
		RR_HWY11_30781	XS 30781.33	levee	0.0060	0.0100	0.0995	0.2306	0.4080	1.0000	0.9703	0.8413	0.6182	0.4077	0.2738
		RR_DN XS 31115	RR_DN XS 31115	levee	0.0010	0.0010	0.0136	0.0336	0.0662	1.0000	1.0000	0.9995	0.9904	0.9611	0.9151
		RR_UP XS 31143	RR_UP XS 31143	levee	0.0010	0.0020	0.0178	0.0438	0.0857	1.0000	1.0000	0.9973	0.9756	0.9200	0.8445
		US_of_RR_31442	XS 31442.86	levee	0.0010	0.0020	0.0229	0.0564	0.1095	1.0000	0.9999	0.9922	0.9549	0.8715	0.7732
		US End 32401	US end of Roseau XS 32401	levee	0.0010	0.0020	0.0152	0.0375	0.0736	1.0000	1.0000	0.9986	0.9845	0.9461	0.8883
E_Div_150ft	East Diversion 150ft BW	ED150 XS 733	ED150 XS 733	levee	0.0010	0.0020	0.0150	0.0371	0.0727	0.9999	0.9992	0.9912	0.9565	0.8621	0.7772
		ED150_XS_1845	ED150 XS 1845	levee	0.0010	0.0010	0.0121	0.0300	0.0591	0.9999	0.9991	0.9910	0.9589	0.8806	0.8182
		ED150 XS 3049	ED150 XS 3049	levee	0.0010	0.0020	0.0156	0.0384	0.0754	0.9999	0.9991	0.9907	0.9549	0.8560	0.7662
		ED150 XS 4415	ED150 XS 4415	levee	0.0010	0.0020	0.0166	0.0409	0.0801	0.9999	0.9992	0.9909	0.9539	0.8478	0.7506

****** - Computations have not been completed.
\+ - Something has changed and computations need to be redone.

HEC-FDA Results for 150 foot Bottom Width East Diversion Alternative

Roseau2 Project Performance
by Damage Reaches for the Ediv_350ftBW
(East Diversion 350ft BW) plan for Analysis Year 2004
(Stages in ft.)
Plan was calculated with Uncertainty

Without Project Base Year Performance Target Criteria:
Event Exceedance Probablility = 0.01
Residual Damage = 5.00 %

Stream Name	Stream Description	Damage Reach Name	Damage Reach Description	Target Stage	Target Stage Annual Exceedar Probability		Long-Term Risk (years)			Conditional Non-Exceedance Probability by Events					
					Median	Expecte	10	25	50	10%	4%	2%	1%	.4%	.2%
Roseau River	City of Roseau	TrtPlnt_26586.4	Nr.Treatment Plant XS 26586	levee	0.0010	0.0020	0.0197	0.0486	0.0949	1.0000	0.9997	0.9919	0.9503	0.8264	0.6906
		XS 28653	XS 28653	levee	0.0010	0.0020	0.0244	0.0599	0.1162	1.0000	1.0000	0.9953	0.9605	0.8419	0.6998
		DS end 29449	DS end of Town XS 29449	levee	0.0010	0.0020	0.0245	0.0602	0.1169	1.0000	1.0000	0.9957	0.9613	0.8390	0.6920
		DS_Hwy11 30203.8	XS 30203.8	levee	0.0010	0.0030	0.0320	0.0782	0.1503	1.0000	0.9999	0.9905	0.9325	0.7599	0.5812
		Section 30532	XS 30532	levee	0.0010	0.0010	0.0132	0.0327	0.0644	1.0000	1.0000	1.0000	0.9964	0.9639	0.8967
		Hwy11Up 30576	Hwy11 Upstream Section 30576	levee	0.0010	0.0030	0.0317	0.0773	0.1487	1.0000	0.9997	0.9874	0.9314	0.7723	0.6115
		CenterSt_D 30745	Center St XS 30745	levee	0.0010	0.0030	0.0291	0.0711	0.1371	1.0000	0.9998	0.9909	0.9434	0.7964	0.6389
		RR_HWY11_30781	XS 30781.33	levee	0.0010	0.0030	0.0297	0.0726	0.1400	1.0000	0.9999	0.9903	0.9410	0.7907	0.6276
		RR_DN XS 31115	RR_DN XS 31115	levee	0.0010	0.0010	0.0100	0.0248	0.0490	1.0000	1.0000	1.0000	1.0000	0.9982	0.9895
		RR_UP XS 31143	RR_UP XS 31143	levee	0.0010	0.0010	0.0105	0.0260	0.0513	1.0000	1.0000	1.0000	0.9998	0.9932	0.9745
		US_of_RR_31442	XS 31442.86	levee	0.0010	0.0010	0.0112	0.0278	0.0547	1.0000	1.0000	1.0000	0.9991	0.9856	0.9539
		US End 32401	US end of Roseau XS 32401	levee	0.0010	0.0010	0.0102	0.0253	0.0499	1.0000	1.0000	1.0000	1.0000	0.9965	0.9838
E_Div_150ft	East Diversion 150ft BW	ED150 XS 733	ED150 XS 733	levee	0.0010	0.0030	0.0308	0.0753	0.1450	0.9882	0.9757	0.9670	0.9599	0.9522	0.9474
		ED150_XS_1845	ED150 XS 1845	levee	0.0010	0.0040	0.0356	0.0866	0.1658	0.9866	0.9717	0.9615	0.9530	0.9439	0.9381
		ED150 XS 3049	ED150 XS 3049	levee	0.0010	0.0030	0.0295	0.0721	0.1391	0.9890	0.9769	0.9686	0.9617	0.9543	0.9495
		ED150 XS 4415	ED150 XS 4415	levee	0.0010	0.0030	0.0293	0.0716	0.1381	0.9892	0.9771	0.9689	0.9620	0.9546	0.9500

***** - Computations have not been completed.
+ - Something has changed and computations need to be redone.

HEC-FDA Results for 350 foot Bottom Width East Diversion Alternative

Geotechnical (geology, HTRW)

ROSEAU FLOOD CONTROL

FEASIBILITY STUDY

GENERAL GEOTECHICAL ASSUMPTIONS

14 May 2004

In the preparation of the feasibility level of detail layout and quantities for this project, many assumptions were made. The assumptions were made due to lack of existing data or other uncertainties. The assumptions are listed below:

1. Slope Stability Analysis: The presence of slickenslide clays was not found in any borings or CPTU soundings acquired in Nov/Dec 2003. These weak clays were assumed to not be present for the preliminary stability analysis. This assumption could change if this material is found in follow-up explorations. It is known that slickenside clays were found in borings acquired in 2002, on the west bank of the river by the low head dam. This is the only area where these weak clays have been found so far. The current levee alignment avoids placing material near the riverbank in this area. The results of the preliminary stability analysis show that 1v:3h cutback slopes of the existing riverbank, with a levee built as an extension of this cutback, will be acceptable.

2. Levee Alignment: The alignment of the levees in town was based on the alignment laid out in Figure 4 of the Northwest Minnesota Draft 2002 Flood Assessment, dated January 2003. The following deviations were made from this initial alignment:

A. The levees in town were setback in 2 places: By the war memorial on the east side, and by the dam on the west side. The setback distance is estimated to be about 75ft to 100ft. These areas were identified in the Corps PL99 Levee Inspection Report, dated October 2002, as having slope stability problems.

B. The south end of the east side was realigned so that a nearby creek was left outside the levee.

C. Between Center St and the RR bridge on the west side of town, the levee was realigned to run along the top of the riverbank to account for the proposed interior flood control pond.

3. Existing Levees: There are a number of existing levees running along the riverbank in Roseau. For this study, it was assumed that these levees would be removed in combination with excavation/reshaping of the existing bank to a flatter slope. Construction of the new levees would follow this work.

4. Levee Fill Material: It was assumed that the top 4ft of levee material would need to be select impervious fill (clay fraction less than 40% and a plasticity index less than 30%). This was found to help eliminate cracking in levees in other Red River Valley projects. The rest of the levee fill could be classified as impervious fill. The 4ft does not apply to the side slopes, only the top 4ft of the levee, similar to a levee cap.

5. Levee Geometry: The levee was assumed to have a geometry typically used in flood control projects with clay levees: 10ft top width and 1v:3h side slopes.

6. Levee Overbuild: Overbuild was assumed to be as follows:

Levee Height (ft)	Overbuild (ft)
0-5ft	0ft
5-10ft	0.5ft
10-15ft	1.0ft
15ft +	1.5ft

7. Diversion Channel Geometry: The side slopes required for all diversion channel were assumed to be 1v:5h, regardless of the depth of cut. The reason for this is that a 1v:5h slope is generally regarded as sufficient to eliminate negative effects of seepage of groundwater into the cut.

8. Diversion Channel Spoil Material: Excess cut material from the diversion channel was assumed to be placed/shaped along the diversion channel alignment outside the channel and channel levees.

9. Erosion Protection: Riprap and bedding overlaying geotextile was assumed to be the scour protection used for this project. The riprap gradation was assumed to be R20 with a 12in minimum thickness above water, 18in. below water. The bedding gradation was assumed to be B1 with a 6in minimum thickness above water, 9in below water.

ROSEAU FLOOD CONTROL

FEASIBILITY STUDY

SUB-SURFACE INVESTIGATION SUMMARY

24 March 2005

This memo provides a summary of the sub-surface investigation that has taken place in the project area. First, information gathered prior to the current project is as follows:

- 5 borings by Midwest Testing Laboratory taken on 03 March 1999. The borings were taken on the west side of the river along the levee that runs from Highway 11 north to the dam. These borings were taken as part of the investigation for a project to move a portion of the levee further from the riverbank.

- 3 borings by Braun Intertec taken on 08-09 October 2002. The borings were taken on the west side of the river in the vicinity of the dam, North of Highway 11. These borings were taken as part of the investigation for a project to repair a slide that had occurred on the west bank of the river, just upstream of the dam. Laboratory testing data is available for these borings.

The information gathered for the current Corps of Engineers feasibility study is:

- 4 borings by Interstate Drilling Services, under the supervision of a Corps geologist, taken on 04-07 November 2003. The borings were taken on the west side of the river between Center St on the north and the railroad embankment on the south. These were taken to provide information for a interior flood control ponding area that has been designed by Barr Engineering, as well as the current Corps study. Laboratory testing data is available for these borings.

- 18 CPTU, or Cone Penetrometer Tests with pore pressure readings, were taken on 03-05 December 2003. The CPTU soundings were taken in various locations over the project area to provide an indication of the general stratigraphy in the area.

ROSEAU FEASIBILITY STUDY

CREDIT TO EXISTING LEVEES

22 March 2005

I. INTRODUCTION

This document is part of the Roseau Flood Control Feasibility Study. The town of Roseau is currently protected by a system of levees lining both sides of the Roseau river as it runs through town. The purpose of this document is to assess the condition of the existing levees, and to determine the baseline level of protection that the existing levees provide to the town.

In order to determine the potential for failure, other than by overtopping, of the existing levee system, a risk-based analysis of levee reliability has been performed in accordance with Policy Guidance Letter No. 26, ER 1105-2-100, and Appendices A and B of ETL 1110-2-556. Slope stability was the failure mode considered in this reliability analysis.

II. EXISTING CONDITIONS

The levees currently protecting the town of Roseau were constructed under flood emergency conditions. Some of these levees have been improved in the time since their construction, but they were all initially built as emergency levees.

The levees were inspected in 1996 and 2002 for inclusion in the Non-Federal Flood Control Works Rehabilitation and Inspection Program (RIP) offered to communities by the Corps of Engineers. The levees were given unsatisfactory ratings for both inspections, and thus were

rejected for participation in the RIP. The following deficiencies with the levees were noted during the inspections:

- The presence of landslides resulting from the proximity of the levees to the river channel
- Unwanted vegetative growth (large trees growing on levee slopes)
- Encroachments
- Unacceptable levee geometry
- Questionable levee materials and construction methods

To assess existing conditions, the levees in town were divided into 10 separate reaches based on when the levees were constructed, what material the levees consist of, and which side of the river they fall on. The reaches were labeled A through J, with reaches A through F running north to south on the east side of the river, and reaches G through J running north to south on the west side of the river. Existing conditions were obtained from a variety of sources including: An inspection in November 2004, Corps of Engineers Non-Federal Levee Inspection Program reports from 1996 and 2002, discussions with city personnel concerning past performance, a 1999 Flood Damage Reduction Planning Report prepared for the city by JOR Engineering, and construction drawings detailing repairs made to Reach G in 1999 and 2003.

Reach A: Reach A runs from high ground on the north end to 6th St NE on the south end. It was constructed in 1997 by the Corps of Engineers during a flood emergency. The levee was constructed of clay and varies from 5ft to 8ft in height along its length.

Reach B: Reach B runs from 6th St NE on the north end to Highway 11. It was initially constructed in the mid 1960s during a flood emergency as a sand/silty sand levee, with plastic sheeting covering the riverward side of the levee. Sandbags were placed on the sheeting to hold it in place. After the flood, the levee was covered with topsoil and vegetation was established on it. Not surprisingly, this levee has experienced seepage problems during flood events. The levee also has many large trees growing on its sideslopes.

Reach C: Reach C runs from Highway 11 on the north end to Center St on the south end, and consists of 2 different levees, a sand levee, and a clay levee. First, the sand levee was constructed along the top edge of the riverbank in the mid 1960s during a flood emergency as a sand/silty sand levee, with plastic sheeting covering the riverward side of the levee. Sandbags were placed on the sheeting to hold it in place. After the flood, the levee was covered with topsoil and vegetation was established on it. This levee has experienced seepage problems during past flood events. Also, the levee has experienced slope stability problems in the past, most likely due to its proximity to the riverbank, and erosion causing a loss of resisting force at the riverward toe. Second, the clay levee was constructed in 2004 by the Corps of Engineers during a flood emergency. The levee was built to a river stage of 22ft to 23ft. This levee served as a backup levee in case failure by the previously described the sand levee. The levee ties into Highway 11 on the north end, and ends about 150ft from Center St on the south, where it ties into high ground. There is a 15ft wide opening in this levee to allow for street access.

Reach D: There is a roughly 300ft long levee in Reach D, running from Center St on the north end to high ground on the south end. The levee is only about 3ft high, and the levee material is unknown.

Reach E: Reach E consists of a clay levee constructed in 1997 by the Corps of Engineers during a flood emergency. It runs south from the railroad embankment for about 300ft where it ties into high ground. The levee ranges from 5ft to 8ft in height.

Reach F: Reach F runs from the end of 7th St SE on the north end to 11th Ave SE on the south end. The levee was constructed of clay in 2004 by the Corps of Engineers during a flood emergency. The levee was built to a river stage of 22ft to 23ft. After the 2004 flood, a large portion of the levee, roughly 400ft, was removed for access to 9th St.

Reach G: Reach G runs from the dam on the north end to Highway 11 on the south end. An emergency levee was constructed in the mid 1960s during a flood emergency as a sand/silty sand levee, with plastic sheeting covering the riverward side of the levee. Sandbags were placed on the sheeting to hold it in place. After the flood, the levee was covered with topsoil and vegetation was established on it. In 1999, portions of the levee were moved landward in a city-sponsored project. In 2003 repairs were made to the portion right near the dam because of a landslide that occurred in this area. Also the area has a history of seepage problems during flood events, so an emergency clay backup levee was constructed in 2004 around the area of greatest concern. This clay levee was built to a river stage of 22ft to 23ft. There are also a lot of trees on the riverward slope of the levee in the southern portion of the reach.

Reach H: Reach H runs from Highway 11 on the north end to Center St on the south end. This area has exhibited signs of landslides in the past. This reach was added to in the 2004 flood emergency by the Corps of Engineers. A clay levee was constructed to a river stage of 22ft to 23ft and placed on right top of the riverbank due to the lack of space from buildings in the area. After the flood, the material was not removed and a large slide occurred.

Reach I: Reach I runs from Center St on the north end to the railroad on the south end. The majority of the reach is protected by a levee of unknown composition, but it is most likely sand. The date of levee construction is unknown as well. Seepage problems have been reported in this reach during past flood events. In 2004, the Corps of Engineers constructed an emergency clay levee in the northern portion of this reach. The clay levee was built to a river stage of 22ft to 23ft.

Reach J: Reach J runs from the railroad on the north end to high ground near the hospital on the south end. The levee was constructed of clay in 2004 by the Corps of Engineers during a flood emergency. The levee was built to a river stage of 22ft to 23ft. There is one opening in the levee, roughly 100ft wide, to allow for street access.

Environmental (natural, archeological, cultural)

Environmental Input

Contact with the U.S. Fish and Wildlife Service and the Minnesota Department of Natural Resources was initiated in February of 2004 to inform these agencies of the existence and scope of the project. An agreement was reached between the COE and the FWS in April of 2004 on the participation of Service in the project study under the Fish and Wildlife Coordination Act. Field trips to proposed project location were made with the FWS personnel in May and July of 2004. During each of these visits, discussions were held with the MDNR. The FWS submitted a planning aid letter on November 23, 2004 that delineated the areas resources and the Service's initial concerns and recommendations. Coordination has continued with the FWS as the likely recommended alternative has been identified. We will continue to try to more fully integrate the MDNR into the planning process.

Planning for the proposed project will continue to minimize potential adverse impacts and maximize beneficial environmental impacts to the extent possible. The creation of a diversion channel, likely to be a major component of the recommended plan, has several opportunities to convert what has been agricultural lands into wildlife corridor and riparian areas. We will work with the local sponsor, watershed district, and natural resource agencies to maximize this opportunity.

A variety of Precontact and Historic cultural resources are located within, or proximal to the project area. Once the alternative(s) are decided, the Area of Potential Effect will be defined. While some of these sites have been investigated, it is expected that most of the project area will require a Phase I cultural resources survey and appropriate follow-up investigations, as warranted. Meanwhile, consultation with the Minnesota State Historical Society and Native American groups will take place. The project construction schedule will partly dictate the need for various Section 106 related instruments, such as a programmatic agreement. To date, the Corp's cultural resources effort on the project includes a preliminary literature review and formulation of a predictive model for cultural resource site location across the broad project area.

Roseau Cultural Resources Status

A variety of Precontact and Historic cultural resources are located within, or proximal to the project area. Once the alternative(s) are decided, the Area of Potential Effect will be defined. While some of these sites have been investigated, it is expected that most of the project area will require a Phase I cultural resources survey and appropriate follow-up investigations, as warranted. Meanwhile, consultation with the Minnesota State Historical Society and Native American groups will take place. The project construction schedule will partly dictate the need for various Section 106 related instruments, such as a programmatic agreement. To date, the Corp's cultural resources effort on the project includes a preliminary literature review and formulation of a predictive model for cultural resource site location across the broad project area.

Recreation

CEMVP-EC 25 March 2005

MEMORANDUM FOR: Roseau Planning Team Leader, Ed McNally

SUBJECT: Conceptual Recreation Alternatives, Roseau Project.

The flood control and reduction features of the East Diversion Alternative of the Roseau Flood Damage Reduction Study could support several different types of recreational features and functions without affecting the functionality of the diversion or significant alterations. A conceptual illustrative graphic of this recreation proposal is attached. The proposal includes:

- A multipurpose walking/biking trail using the flood reduction structures and connecting to the city at both ends. This could provide a 4-10 mile trail loop, depending on its layout.
- A motorized trail utilizing the flood reduction features—this would be especially desirable when considering that Polaris Industries is based in Roseau. An important design consideration for this feature will be designing and ensuring definite separation between motorized and non-motorized recreation functions.
- A parking area at the junction of the project and Highway 11 would provide additional functionality to the proposed recreation features.
- Sanitary facilities at the parking area should be provided for project recreational users; this area could serve as a trailhead for the various trail features.
- A sledding hill, constructed with spoil from the channel excavation. Connecting this feature to the walking trail could provide an elevated scenic overlook. The hill should be accessible from the main parking area for drop-off and pick-up purposes.
- The possibility of a canoe trail on the Roseau River, extending from the upstream diversion structure through the city to the downstream channel outlet. A short portage at the dam would be required, which could also function as a midway takeout/put-in point on the trail and an access to the dam area for area fishers. This feature would require three small gravel-parking areas.
- A nature trail loop could extend from the walking trail into the habitat restoration areas, it could include interpretive signage and an overlook/rest area.
- A small picnic area with tables and grills, location to be decided after further analysis.

In general, all recreation features and amenities provided by the project would be universally accessible in accordance with the Regulatory Committee on Accessibility Guidelines for Outdoor Developed Areas, Final Report September 1999.

This proposal ties into existing city recreation and provides accessible recreation functions currently unavailable to city and area residents. The concept supports Roseau City's goals for future development and greatly expands the existing recreation base of the city, providing additional recreation opportunities to city and area residents.

John Fisher, Landscape Architect

General Engineering, Design Branch

Engineering and Construction Division

Saint Paul District, U.S. Army Corps of Engineers

Enclosure


Roseau Flood Reduction Project–East Diversion
HABITAT POSSIBILITIES
Open Ponding Areas
Marsh
Wet Meadows
Prairie
Oak Savanna
Riparian Forest
Channel Outlet
Ponding Area
Marsh
Scenic Overlook
Wet Meadows
Interpretive
Nature Trail
Open Prairie
Canoe Trail
Riparian Forest
Walking Trail, North Loop
Levee
Diversion Channel
Oak Savanna
Sledding Hill
Canoe Portage
Trail Head
River Access
Parking Lot
Walking Trail, South Loop
Canoe Trail
Oak Savanna
Riparian Forest
Motorized Trail
Stricture Structure
Channel Inlet
Roseau, Feels Like Home
RECREATION POSSIBILITIES
Multi-Purpose Trail Loop
River Canoe Trail
Motorized Trail
Sledding Hill
Parking Lots
Restrooms
Picnic Areas
Playgrounds
Trail Head
Overlook
Interpretive

General Engineering and related Design Functions

General Engineering

21-Mar-05, G. Wolf

East Diversion Quantities

Assumptions

Channel Horizontal Alignment: From Scott G. email dated 3-10-05. I modified alignment slightly to avoid structures, most notably, the STP.

Channel Vertical Alignment: From Scott G. email 3-2-05. Overbuild adjustment: Levee height 0-5', no overbuild; 5-10', 0.5' overbuild; 10-15', 1.0' overbuild.

Channel Width: Scott G. email 3-2-05. 150', 50' and 350'. At HWY 11 & RR, 150' channel necks to 125'; 350' channel necks to 175'.

Channel side slopes: From Jeff S., 1:5

50' aggrebate surface across beginning of channel

Pilot channel geometry: From Scott G. email 3-2-05. 10' bottom width. From Jeff S., 1:3 side slopes.

Pilot channel horizontal alignment: Based on discussions with Scott G. For 150' and 350' diversion, the pilot channel meanderes. For 50' diversion, the channel follows the centerline of the diversion.

Pilot channel vertical alignment: From Scott G. email 3-2-05.

Pilot channel runs from beginning of diversion to Hay Creek.

High flow cut: From Scott G email, 3-2-05. 150' channel bottom, 1:5 side slopes. Invert el.=1039.0

Base levee geometry: 10' top width, 1:3 side slopes.

Levees are not necessary to hold back water south of HWY 11. Levees are necessary north of HWY 11

South of Hwy 11, excavated material will be disposed of on each side of channel. Material will

be shaped with 1V:5H side slopes and varying top widths. Height is approx. 8' above existing ground.

North of Hwy 11, excavated material will be used to construct levees and sled hill. A segment of the top width of the western levee will be increased beyond 10' to utilize excavated material.

Per Jeff S. side levees/disposal areas should be 10' above existing ground maximum.

CR 28 must be raised and will be levee on east side of diversion. 30' top width, 0.5' aggregate base, -2% slope from crown, 1:4 side slopes.

CR 28 will be raised running North/South until just north of treatment plant, then turn east and tie into high ground near Hay Creek.

Restriction structure: Scott G. email 3-2-05. Top el 1053.5. 45' clear span, 50' long.

Restriction structure side slopes: Per Jeff S, 1:3.

Strip 6" from channel/levee footprint.

4" topsoil and seed on diversion bottom & side slopes; 6" topsoil & seed on levee top & side slopes, except where aggregate is placed.

10' wide aggregate driving surface on top of levees. 20' wide aggregate surface on spoil piles to get equipment to diversion & restriction structure.

Bridges necessary at Hwy 11 and Railroad.

Texas crossing at CR 24

EW Road Removal: Road running East/West just north of sewage treatment plant will be removed to surrounding ground elevation, new 18' wide aggregate surface will be provided.

EW Road Removal: Existing road is approx 18' wide, 2' above surrounding ground, 1:3 side slopes.

Wider diversion = higher diversion levees = lower west tie back levee.

REAL ESTATE

Downstream of HWY 11, assume a floodway extending from the west levee centerline a minimum of 1000' to the east.

Where diversion ends and "lake" forms, assume entire area will be acquired.

In other areas, assume 20' from the toe as work limits.

Levees Quantities (as stand alone)

Minnesota State Plane North Zone NAD 83 Feet

NAVD 88 Feet

Lidar Base Topo

City provided map showing sanitary, storm, and water locations

Color aerial photo taken Summer '03

Assumptions

1. Levee Alignment:

A) Attempted to miss as many structures as possible. If they could not be avoided, assume they will be taken.

B) Avoided all road raises.

C) In rural areas where levee crosses a road, assume road will ramp over the levee. The quantities for these ramps are minimal and are not included.

D) Closure structures provided where levee crosses HWY 11, Center Street, and Railroad.

E) A base horizontal alignment was arrived at, and was not changed for the different levels of protection. "Tieback" levees were added to the base alignment

in areas where we needed to tie into higher ground.

F) For these quantities, did not use floodwall except at City Center. Use of floodwalls in some areas may save real estate costs.

G) On East side of river, south end of town, there is a row of high priced homes close to the river. Levee may not fit in this area, but need more accurate base

mapping to determine. For these quantities, assume levee will fit.

2. Top of Barrier Elevation: From Scott G spreadsheet attached to email dated 2-15-05.

3. Levee Section: 10' top width, 1:3 sideslopes, 6" aggregate on top, 6"topsoil & seed on slopes, 6"stripping beneath, impervious fill.

(top 4' of levee section will be select imprevious fill, and the rest impervious fill. Costs for these should be similar, so fill quantities are not broken up)

4. Levee Overbuild:

A) 0-5', no overbuild

B) 5'-10', 0.5' overbuild

C) 10'-15', 1.0' overbuild

5. River Bank Cutback: 1:3 from channel bottom up to existing ground. Had limited info on channel bottom elevation. Should be taken as approximate.

6. New City Center

A) Assume City adds 3' of fill in area of building, no fill in parking lot area. (per Bill Spychalla, Barr Engr.)

B) Assume approx. 320' of invisible floodwall base will be constructed by the City. Corps will be responsible for aluminum stoplogs up to top of barrier elevation

C) Assume approx. 320' of concrete floodwall will have to be constructed by Corps project (behind proposed Parking Lot, running North up to Highway 11.) (Tony Fares will provide quantities???)

7. Inspection trench entire length of levee/floodwall/road raise (not including storm water retention basin and city built floodwall).

8. Sanitary/Water Main crossings (handle similar to Grand Forks/East Grand Forks, info from Ralph Berger) Assume all existing lines are sound and can support weight of levee.

A) Water lines crossing under levee will have to be valved on both sides, and be deep enough to be below inspection trench. Lines should already be sufficiently deep, just need to valve.

B) Sanitary lines that cross the levee to the wet side will have to be valved and will be out of service during floods, and also be below inspection trench. Lines should already be sufficiently deep, just need to valve.

C) Interior drainage by combining storm sewers, constructing holding ponds, and constructing gatewells. Use Barr Engineering Report as a guide.

9. Rip Rap on bank cut back per Scott Goodfellow email dated July 14, 2004. Depth & geotextile per Jeff Stanek email dated July 14, 2004.

A) R20, 12" thickness above water, 18" thickness below water, geotextile underlay.

B) Topsoil & Seed above top of rock elevation

10. Do not have data on power line location, gas line location, culvert location, cable line location, water valves.

11. **REAL ESTATE**

A) Work limits 20' from toe of levee

B) For channel cut back, use actual cut area for work limits.

---------- late addition----------

Just wanted to inform you of a couple of things:

1. I omitted inspection trench quantities for the diversion levees.

2. The sewage treatment plant lagoons currently discharge to the swale to the west of the plant, then flow overland to the Roseau River. Our diversion channel intercepts this swale. So, post project, the treatment plant discharge would flow into the diversion channel and be conveyed, via the pilot channel, to Hay Creek. As I see it, this should not be a problem. They perform effluent monitoring at the lagoon effluent, and this would not change. Only difference would be that it will flow overland to Hay Creek instead of the Roseau River.

3. The sewage treatment plant influent line is a 12" diameter force main, that will pass under the diversion channel, and the levee to the west of the channel. May have to do a little work on this line (possibly lower a portion, provide valving), but nothing major.

Gary

Real Estate

PRELIMINARY REAL ESTATE COST ESTIMATE
FEASIBILITY STUDY - FLOOD CONTROL PROJECT
ROSEAU, MINNESOTA

CEMVD-RE-PA March 14, 2005

SCOPE: The scope of this report is to estimate the value of the necessary real estate interests for three flood control alternatives for the City of Roseau, Minnesota. It has been prepared for use as a planning tool for the U.S. Army Corps of Engineers, St. Paul District.

1. The following assumptions/limitations and clarifying statements are considered in evaluating the information given:
   a) Support for the valuation conclusion is taken from previous appraisals of lands in the general area, the University of Minnesota Extension Service's Land Value Survey, City of Roseau Planning and Zoning Dept. and Roseau county tax assessors' records.
   b) Needed acreages were estimated from a map showing an approximate outline of area needed for the project.
   c) The real estate for each feature may ultimately be acquired in Fee Simple Estate, Permanent Easement, or Temporary Easement; however, the available project maps do not provide sufficient detail to adequately identify the needed estates. Therefore, this cost estimate has been calculated at Fee Simple Estate value.
   d) The preliminary drawings appear to indicate that both residential and commercial structures maybe within the planned area of the project. Acquisition of these properties would require relocation of the property owners under Public Law 91-646. This cost has also been estimated for each alternative.
   e) Real estate cost estimates in the planning stages typically include an allowance for contingencies of 25% for unknown costs which can arise. They can include but are not limited to the following: changes in final plans and specs; required borrow areas; severance damages identified during the acquisition phase; and potential increases in real estate values.

The calculated values have been based on the following estimated lands and structures which appear to be within the project alignment:

CITY OF ROSEAU

	Urban Lands –	Rural Lands –	Structures
25 Year Level	43.69 Acres	49.00 Acres	20 Homes – 3 Commercial
100 Year Level	49.66 Acres	55.60 Acres	30 Homes – 3 Commercial
500 Year Level	53.50 Acres	59.19 Acres	40 Homes – 3 Commercial

LAND AND DAMAGES

	25 Year Level	100 Year Level	500 Year Level
Lands & Damages	$1,991,336	$2,263,270	$2,437,000
Structure Acquisitions	$3,200,000	$4,200,000	$5,200,000
Relocation Costs	$ 640,000	$ 910,000	$1,180,000
Sub Total	$5,831,336	$7,373,270	$8,817,000
Contingencies 25% ®	$1,457,834	$1,843,317	$2,204,250
TOTAL	$7,289,170	$9,216,587	$11,021,252

Prepared by: John P. Albrecht, Certified General Real Estate Appraiser

US Army Corps of Engineers, St. Paul District

PRELIMINARY REAL ESTATE COST ESTIMATE

RECON STUDY – FLOOD CONTROL PROJECT

EAST CHANNEL DIVERSION WITH LEVEES

ROSEAU, MINNESOTA

CEMVP-RE-PA March 23, 2005

SCOPE: The scope of this report is to estimate the value of the lands and necessary real estate interests for a potential flood control project for the City of Roseau, Minnesota. It will be prepared for use as a planning tool for the U. S. Army Corps of Engineers, St. Paul District.

1. The following assumptions/limitations and clarifying statements must be considered when using and evaluating the information supplied.

    a) Support for the unit value was extracted from other documents and valuation issues that were completed within the office.

    b) Acreages and areas to be encumbered for project purposes were estimated by General Engineering using common and customary alternatives as to the height and width of the levee and channel proposed to be constructed.

    c) Real Estate interests for this alternative were estimated in Fee Title assumptions, however may ultimately be acquired in permanent easement, and temporary easement which could lower the value conclusion.

    d) Preliminary drawings appear to indicate that one rural residential site may be affected. For this estimate it was concluded that one site was affected.

    e) Due to the inclusiveness of the mapping, sites to place spoil, borrow areas, severance damages and general nature of the engineering drawings, 25% c contingency was added.

This revised cost estimate is for the alternative, East Diversion Channel and Levee tye back system supplied to us by General Engineering on March 23, 2005.

CITY OF ROSEAU

LANDS AND DAMAGES

	50 foot Channel	150 foot Channel	350 foot
Land	$1,357,380	$1,473,300	$1,693,800
Structures	$ 250,000	$ 250,000	$ 250,000
Relocation	$ 100,000	$ 100,000	$ 100,000
Subtotal	$1,707,380	$1,823,300	$2,043,800
Contingencies 25%	$ 426,845	$ 455,825	$ 510,950
TOTAL	$2,134,225	$2,279,125	$2,554,750

Total Estimated Lands and Damages for the East Diversion Channel and Levee tye-back alternative.

LARRY R. JOACHIM

Chief, Appraisal Branch